



**Source Emissions Testing Report
Becton-Dickinson Medical**

**Ethylene Oxide Sterilization Chamber
Catalytic Oxidizer**

**BD Medical Plant
Sandy, Utah**

Test Date: August 2, 2017

Report prepared for:
Becton-Dickinson Medical
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APT Project: BDM7041

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Certification

Team Leader Certification:

I certify that all of the sampling and analytical procedures and data presented in this report are authentic and accurate.

A handwritten signature in black ink, appearing to read "Ken Moody".

Ken Moody
Field Team Leader / Project Manager

Reviewer Certification:

I certify that all of the testing details and conclusions are accurate and valid.

A handwritten signature in black ink, appearing to read "Marty Willinger".

Marty Willinger
Reviewer / Technical Writer



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Test Report – Becton-Dickinson Medical
Sandy, Utah Facility – Ethylene Oxide DRE
APT Project: BDM7041

1. Introduction

Air Pollution Testing, Inc (APT) was contracted by Becton-Dickinson Medical (BD Medical) for emission testing services at the BD Medical facility located in Sandy, Utah.

Ethylene oxide sterilization chambers are in service at the facility. A catalytic oxidizer is used to control ethylene oxide (EO) emissions from the source. The purpose of the emissions testing program is to quantify the concentrations and mass rates of EO into and out of the catalytic oxidizer to determine the EO destruction removal efficiency (DRE) on a mass basis.

The test program satisfied applicable requirements imposed by the United States Environmental Protection Agency (EPA) and the Utah Division of Air Quality (UDAQ). The facility is subject to the emission limits and testing requirements provided in *40 CFR Part 63 National Emission Standards for Hazardous Air Pollutants (NESHAP) Subpart O – Ethylene Oxide Emissions Standards for Sterilization Facilities*. The unit demonstrated an EO DRE greater than 99%. Testing was conducted on August 2, 2017.

Table 1.1 provides key project personnel, company affiliations and contact information. Source identification and standards are summarized in Table 1.2.

BD Medical : Sandy, Utah Facility, Catalytic Oxidizer, Ethylene Oxide DRE Testing Program Contact Personnel		
Name, Title	Company Address	Contact Information
Mr. John Jensen, Plant Engineering Manager	BD Medical 9450 State Street Sandy, Utah 84070	801-565-2605 john_jensen@bd.com
Mr. Robert Partner, Safety/Environmental Engineer		801-565-2507 bob_partner@bd.com
Mr. Jeff Powell, Sterilization Engineer		801-565-2551 801-509-0429 cell jeff_powell@bd.com
Mr. Joe Randolph, Air Quality Engineer	Utah DAQ 195 North 1950 West Salt Lake City, Utah 84116	801-536-4173 jrandolph@utah.gov
Mr. David Maiers, Director of Operations	Air Pollution Testing, Inc. 5530 Marshall Street Arvada, Colorado 80002	303-420-5949 x 33 dmaiers@airtest.net

Table 1.1: Testing Program Contact Personnel

BD Medical : Sandy, Utah Facility, Catalytic Oxidizer, Ethylene Oxide DRE Source Identification Summary	
<i>Source Identification</i>	<i>Standards and Operating Limits</i>
Catalytic Oxidizer	Ethylene Oxide DRE \geq 99% Catalyst bed outlet temperature to be recorded

Table 1.2: Source Identification Summary

2. Test Results Summary

The results of the testing program are summarized in Table 2.1 on the following page. Any emission parameters not presented in the table may be found in *Appendix 1*. Field data, including GC chromatograms are included in *Appendix 2*. Operating data is provided in *Appendix 3*. The following terms are used in the table:

- %vd – diluent concentration, dry volume percent
- %vw – stack gas moisture content, wet volume percent
- DRE – destruction removal efficiency
- dscfm – gas flow rate, dry standard (one atm., 68°F) cubic feet per minute
- EO – ethylene oxide
- lb/hr – mass rate, pounds per hour
- ppmvd – pollutant concentration, parts per million dry volume basis
- Temp °F – degrees Fahrenheit

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BD Medical : Sandy, Utah Facility, Catalytic Oxidizer, Ethylene Oxide DRE Ethylene Oxide Catalytic Oxidizer: Test Results (August 2, 2017)						
	<i>Run #1</i>	<i>Run #2</i>	<i>Run #3</i>	Average	Permit Limits	
Start Time	11:30	12:40	13:45			
Stop Time	12:30	13:40	14:45			
Inlet Measurements						
O ₂ (%vd)	20.9	20.9	20.9	20.9		
CO ₂ (%vd)	0.0	0.0	0.0	0.0		
Stack Temp (°F)	119	118	119	119		
H ₂ O (%vw)	2.2	2.3	2.0	2.2		
Gas Flow (dscfm)	4,005	4,616	4,622	4,414		
EO (ppmvd)	1284.9	1267.0	1192.9	1248.3		
EO (lb/hr)	35.3	40.1	37.8	37.7		
Outlet Measurements						
O ₂ (%vd)	20.9	20.9	20.9	20.9		
CO ₂ (%vd)	0.0	0.0	0.0	0.0		
Stack Temp (°F)	20.9	20.9	20.9	20.9		
Catalyst Bed Temp (°F)	186.0	189.5	192.4	189.3		
H ₂ O (%vw)	2.2	2.3	2.0	2.2		
Gas Flow (dscfm)	5,032	5,012	5,037	5,027		
EO (ppmvd)	0.17	0.17	0.17	0.17		
EO (lb/hr)	0.006	0.006	0.006	0.006		
DRE						
EO (lb/hr)	99.99	99.99	99.99	99.99	99%	
EO (ppmvd)	99.98	99.99	99.98	99.98		
A minimum detection limit of 400 area count (0.17 ppmvw) was used to quantify EO emissions.						

Table 2.1: Ethylene Oxide Catalytic Oxidizer Test Results

3. Methods

APT tested in accordance with the following U.S. Environmental Protection Agency (EPA) source emission test methods referenced in 40 CFR Part 60, Appendix A.

- *Method 1 – Sample and Velocity Traverses for Stationary Sources*
- *Method 2 – Determination of Stack Gas Velocity and Volumetric Flow Rate*
- *Method 4 – Determination of Moisture Content in Stack Gases*
- *Method 18 – Measurement of Gaseous Organic Compound Emissions by Gas Chromatography*

4. Test Program Summary

Three (3), 1-hour test runs were conducted to determine the concentrations of EO into and out of the catalytic oxidizer. Concurrent volumetric flow measurements were conducted to calculate mass rates. EO DRE was determined by comparing EO mass rates at the inlet and outlet sampling locations.

Testing involved direct-interface EPA Method 18 on-site gas chromatography to determine the inlet and outlet levels of EO. The GCFID was calibrated with EO balanced nitrogen standards certified to 2% accuracy and dilutions of the certified standards. Due to the presence of methane in the exhaust, a sample of exhaust gas was collected in a Tedlar bag and spiked with 25 ppmv of EO to demonstrate adequate EO quantification and recovery.

Since the gas content at the inlet and outlet locations were essentially air, a dry molecular weight of 29.0 was assumed for stack velocity calculations. Due to the inlet sampling location posing significant EO exposure risks, APT did not conduct EPA Method 4 sampling for moisture determination at the inlet sampling location. Moisture content was measured at the outlet sampling location and assumed the same at the inlet location for volumetric flow rate calculations.

During the test program, the catalyst bed outlet temperature was monitored by BD Medical personnel for inclusion in the test report.

APT provided all equipment for determining the parameters detailed in Table 4.1.

BD Medical : Sandy, Utah Facility, Catalytic Oxidizer, Ethylene Oxide DRE Testing Program Sampling and Analytical Methods Summary			
<i>Parameter</i>	<i>Sampling Method</i>	<i>Analytical Method</i>	<i>Laboratory</i>
gas flow rate	Methods 1 and 2	thermocouple, pitot tube and draft gauge	APT, on-site
O ₂ , CO ₂	Method 2	assumed ambient	
H ₂ O	Method 4	gravimetric	
ethylene oxide	Method 18	gas chromatograph with flame ionization detector	

Table 4.1: Sampling and Analytical Methods Summary

The inlet and outlet sampling locations were EPA Method 1 compliant with two test ports arranged at 90°. Stack gas velocity traverse points were located in accordance with EPA Method 1. Sampling location dimensions are summarized in Table 4.2 and in Appendix 1. All stack measurements were confirmed onsite prior to testing.

BD Medical : Sandy, Utah Facility, Catalytic Oxidizer, Ethylene Oxide DRE Source Information			
<i>Source Identification</i>	<i>Diameter</i>	<i>Upstream and Downstream Distances</i>	<i># Velocity Points</i>
Catalytic Oxidizer - Inlet	23.75"	Upstream – 132" Downstream – 198"	16 Points
Catalytic Oxidizer - Outlet	23.5"	Upstream – 180" Downstream – 64"	16 Points

Table 4.2: Stack Information

5. Test Method Details

5.1. Stack Gas Flow, Diluent, and Moisture Content

Stack gas velocity, volumetric flow rate, diluent (O₂ and CO₂), and moisture (H₂O) content were measured in accordance with EPA Methods 1, 2 and 4.

Each sampling period consisted of conducting a temperature and differential pressure traverse of each sampling location using a K-type thermocouple and an S-type pitot tube. Concurrent with each traverse, a sample of gas for moisture determination was extracted from the stack at a constant flow rate of no more than 0.75 cubic feet per minute (cfm). The gas sample was passed through a stainless steel probe, through a series of four (4) chilled glass impingers, and through a calibrated dry gas meter. Please see *Appendix 5 –Schematics* for a drawing of the EPA Methods 1, 2 and 4 sampling train.

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Prior to sampling, the first two impingers were each seeded with 100 milliliters of water. The third impinger was empty. The fourth impinger was seeded with 250 grams of dried silica gel. Following sampling, the moisture gain in the impingers was measured gravimetrically to determine the moisture content of the stack gas.

The temperature and differential pressure traverse data were combined with diluent data to calculate the stack gas velocity and volumetric flow rate in units of feet per second (ft/sec), actual cubic feet per minute (acf m), dry standard (1 atmosphere and 68°F) cubic feet per minute (dscfm), and pounds per hour (lb/hr). Since the stack gas content is essentially air, a dry molecular weight of 29.0 was assumed for stack gas velocity calculations.

5.2. Ethylene Oxide

Ethylene oxide (EO) levels were determined in accordance with EPA Method 18 using the direct interface sampling and analysis procedures detailed in the method. Samples were analyzed on-site with an HP Model 5890 Series II Gas Chromatograph equipped with dual flame ionization detectors (FID), Chemstation software and RT-Wax columns.

Gas phase calibration standards were prepared by dilution of +/-2% accuracy certified gas standards. Preparation of diluted standards were conducted using a gas-tight volumetric syringe and new Tedlar bags. Triplicate injections were conducted for each standard, and a calibration curve of peak area versus concentration was prepared. A least squares line ($y=mx$) was fit to each data set.

Due to the presence of methane in the exhaust gas stream, prior to the test runs, a sample of exhaust gas was collected in a Tedlar bag. The contents of EO were determined. Then the bag was spiked with a known concentration of 25 ppmv EO to demonstrate adequate EO quantification and recovery.

Ethylene oxide levels were measured at the inlet and outlet simultaneously. A gas sample was transported directly to the GC gas sampling valves using a heated sample line. Samples were analyzed approximately once every 10-minutes. A “test run” consisted of five (5) consecutive injections. Three (3), test runs were conducted (for a total of 15 injections) at the inlet and outlet of the catalytic oxidizer.

Following analysis of stack gas samples, the mid-level calibration standards were re-analyzed at the gas sampling valve in triplicate. The average of the initial calibration response (triplicate average) and the post-test check response (triplicate average) were within 5% of their mean value, the initial calibration linear regression data were used to quantify the emission levels.

The results of the GC analysis were used to calculate EO levels in units of parts per million, wet volume basis (ppmvw). The data were combined with stack gas volumetric flow rate data to calculate EO mass rates in units of pounds per hour (lb/hr). The catalytic

oxidizer DRE was calculated on a mass basis.

6. Conclusions

The testing conducted by APT on the ethylene oxide catalytic oxidizer at the BD Medical facility in Sandy, Utah on August 2, 2017 demonstrated that the catalytic oxidizer is operating in compliance with UDAQ, EPA and *NESHAP Subpart O* standards.



Appendix One: Testing Parameters / Sample Calculations

Becton-Dickinson Medical**BD Medical Facility****Sandy, Utah****Catalytic Oxidizer**

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Field Reference Method Data (Inlet)					
	Run #	1	2	3	Average
	Start Time	11:30	12:40	13:45	
	Stop Time	12:30	13:40	14:45	
	Sample Time	60	60	60	
hrs	Hours of Operation / Year	8,760	8,760	8,760	8,760
D _S	Stack Diameter (inches)	23.75	23.75	23.75	23.75
√ΔP _{AVG}	(Delta P) ^{1/2}	0.5388	0.5364	0.5365	0.5372
C _P	Pitot Tube Constant (unitless)	0.814	0.814	0.814	0.814
T _S	Stack Temp (°F)	119	118	119	119
P _{bar}	Barometric Press (mbar)	867	867	867	867
P _{bar}	Barometric Press ("Hg)	25.60	25.60	25.60	25.60
P _S	Stack Pressure ("H ₂ O)	-7.00	-7.00	-7.00	-7.00
Y _d	Meter Y Factor (unitless)	1.000	1.000	1.000	1.000
T _m	Meter Temperature (°F)	82.6	89.9	93.5	88.7
V _m	Sample Volume (ft ³)	38.975	39.090	39.054	39.040
ΔH	Delta H ("H ₂ O)	1.0	1.0	1.0	1.0
V _{ic}	Moisture (grams)	15.4	16.4	14.1	15
O ₂ %vd	O ₂ (%vd)	20.9	20.9	20.9	20.9
CO ₂ %vd	CO ₂ (%vd)	0.0	0.0	0.0	0.0
N ₂ %vd	N ₂ (%vd)	79.1	79.1	79.1	79.1

Method 18 GC Data (Inlet)					
<u>MW</u>	Run #	1	2	3	Average
44.05	Ethylene Oxide (ppmvw)	1256.92	1237.30	1168.65	1220.96

Reference Method Calculations (Inlet)					
	Run #	1	2	3	Average
V _{mstd}	Sample Volume (dscf)	32.534	32.196	31.958	32.229
V _{wstd}	Moisture Volume (scf)	0.725	0.772	0.664	0.720
B _{ws}	Moisture Content (%/100)	0.022	0.023	0.020	0.022
M _D	Molecular Weight Dry	39.00	29.00	29.00	32.33
M _A	Molecular Weight Wet	38.54	28.74	28.78	32.02
V _S	Gas Velocity (ft/sec)	29.0	33.4	33.4	32.0
F _{ACFM}	Gas Flow (acfpm)	5,358	6,167	6,173	5,899
F _{DSCFM}	Gas Flow (dscfm)	4,005	4,616	4,622	4,414
lb/hr	Gas Flow (lb/hr)	24,570	21,154	21,143	22,289
	Ethylene Oxide (ppmvd)	1284.9	1267.0	1192.9	1248.3
	Ethylene Oxide (lb/hr)	35.3	40.1	37.8	37.7
	Ethylene Oxide (tpy)	154.5	175.6	165.5	165.2

DRE Calculations					
	Run #	1	2	3	Average
dry	Inlet C ₂ H ₄ O (ppmvd)	1284.9	1267.0	1192.9	1248.3
lb/hr	Inlet C ₂ H ₄ O (lb/hr)	35.3	40.1	37.8	37.7
dry	Outlet C ₂ H ₄ O (ppmvd)	0.17	0.17	0.17	0.17
lb/hr	Outlet C ₂ H ₄ O (lb/hr)	0.006	0.006	0.006	0.006
Eff %	Control Eff % C ₂ H ₄ O (ppmvd)	99.99	99.99	99.99	99.99
DRE	%DRE C ₂ H ₄ O (lb/hr)	99.98	99.99	99.98	99.98

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Field Reference Method Data (Outlet)					
	Run #	1	2	3	Average
	Start Time	11:30	12:40	13:45	
	Stop Time	12:30	13:40	14:45	
	Sample Time	60	60	60	
hrs	Hours of Operation / Year	8,760	8,760	8,760	8,760
D _S	Stack Diameter (inches)	23.50	23.50	23.50	23.50
$\sqrt{\Delta P_{AVG}}$	(Delta P) ^{1/2}	0.6183	0.6189	0.6205	0.6192
C _P	Pitot Tube Constant (unitless)	0.814	0.814	0.814	0.814
T _S	Stack Temp (°F)	173	178	178	176
P _{bar}	Barometric Press (mbar)	867	867	867	867
P _b	Barometric Press ("Hg)	25.60	25.60	25.60	25.60
P _s	Stack Pressure ("H ₂ O)	-0.20	-0.20	-0.20	-0.20
Y _d	Meter Y Factor (unitless)	1.000	1.000	1.000	1.000
T _m	Meter Temperature (°F)	82.6	89.9	93.5	88.7
V _m	Sample Volume (ft ³)	38.975	39.090	39.054	39.040
ΔH	Delta H ("H ₂ O)	1.0	1.0	1.0	1.0
V _{ic}	Moisture (grams)	15.4	16.4	14.1	15
O ₂ %vd	O ₂ (%vd)	20.9	20.9	20.9	20.9
CO ₂ %vd	CO ₂ (%vd)	0.0	0.0	0.0	0.0
N ₂ %vd	N ₂ (%vd)	79.1	79.1	79.1	79.1

Method 18 GC Data (Outlet)					
<u>MW</u>	Run #	1	2	3	Average
44.05	Ethylene Oxide (ppmvw)	0.17	0.17	0.17	0.17

The detection limit determined on site was based on a 400 area count, 0.17 ppmvw

Reference Method Calculations (Outlet)					
	Run #	1	2	3	Average
V _{mstd}	Sample Volume (dscf)	32.534	32.196	31.958	32.229
V _{wstd}	Moisture Volume (scf)	0.725	0.772	0.664	0.720
B _{ws}	Moisture Content (%/100)	0.022	0.023	0.020	0.022
M _D	Molecular Weight Dry	29.00	29.00	29.00	29.00
M _A	Molecular Weight Wet	28.76	28.74	28.78	28.76
V _S	Gas Velocity (ft/sec)	39.9	40.1	40.2	40.1
F _{ACFM}	Gas Flow (acfmin)	7,213	7,247	7,263	7,241
F _{DSCFM}	Gas Flow (dscfm)	5,032	5,012	5,037	5,027
lb/hr	Gas Flow (lb/hr)	23,036	22,972	23,039	23,016
	Ethylene Oxide (ppmvd)	0.17	0.17	0.17	0.17
	Ethylene Oxide (lb/hr)	0.006	0.006	0.006	0.006
	Ethylene Oxide (tpy)	0.03	0.03	0.03	0.03

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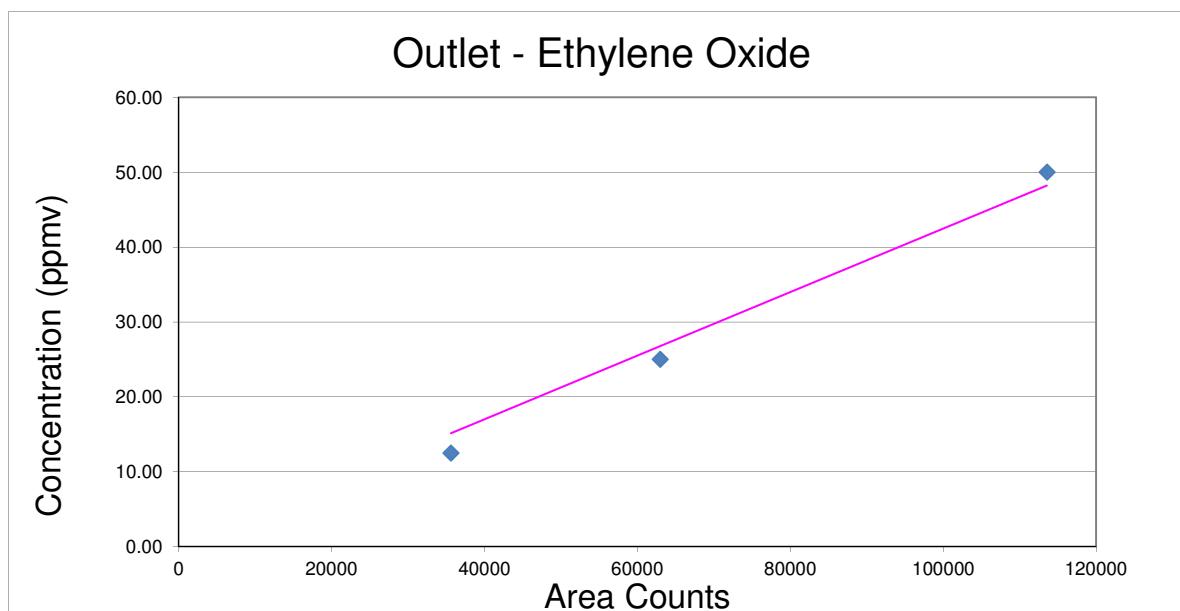
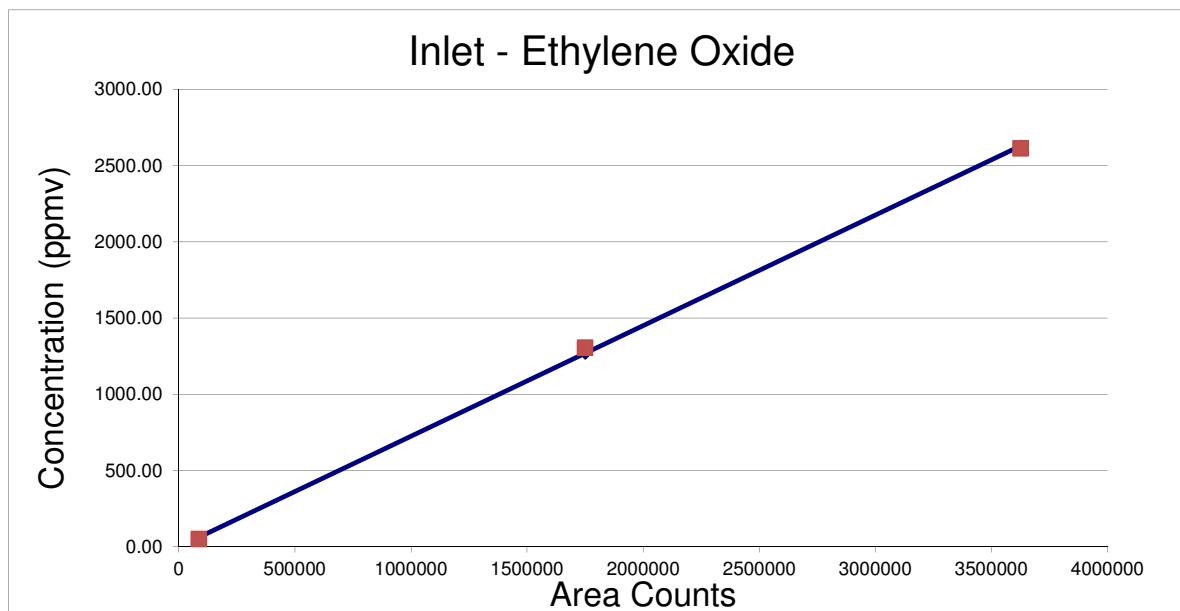
EPA Method 18: Determination of Gaseous Organic Compounds using Gas Chromatography

Inlet - Initial Three-Point Calibration									
(Inlet) High Level Calibration Standard									
Cpd ID	Conc. (ppm)	RT	Inj. 1 AC	RT	Inj. 2 AC	RT	Inj. 3 AC	RT	Average AC OK?
Ethylene Oxide	2611.00	1.676	3620989.8	1.675	3632313.0	1.675	3620540.5	1.675	3624614 Y
Mid-Level Calibration Standard									
Cpd ID	Conc. (ppm)	RT	Inj. 1 AC	RT	Inj. 2 AC	RT	Inj. 3 AC	RT	Average AC OK?
Ethylene Oxide	1305.50	1.676	1748867.9	1.676	1760178.6	1.676	1741926.2	1.676	1750324 Y
Low-Level Calibration Standard									
Cpd ID	Conc. (ppm)	RT	Inj. 1 Sig.20015 AC	RT	Inj. 2 Sig.20016 AC	RT	Inj. 3 Sig.20017 AC	RT	Average AC OK?
Ethylene Oxide	50.02	1.673	87634.1	1.673	87331.7	1.674	87884.9	1.673	87617 Y
Outlet - Initial Three-Point Calibration									
(Outlet) Low Level Calibration Standard									
Cpd ID	Conc. (ppm)	RT	Inj. 1 AC	RT	Inj. 2 AC	RT	Inj. 3 AC	RT	Average AC OK?
Ethylene Oxide	50.02	1.137	115651.9	1.137	112761.2	1.137	112193.8	1.137	113536 Y
Mid-Level Calibration Standard									
Cpd ID	Conc. (ppm)	RT	Inj. 1 AC	RT	Inj. 2 AC	RT	Inj. 3 AC	RT	Average AC OK?
Ethylene Oxide	25.01	1.138	63053.7	1.138	63254.3	1.138	62565.2	1.138	62958 Y
Low-Level Calibration Standard									
Cpd ID	Conc. (ppm)	RT	Inj. 1 AC	RT	Inj. 2 AC	RT	Inj. 3 AC	RT	Average AC OK?
Ethylene Oxide	12.51	1.138	35637.9	1.139	35589.0	1.139	35575.3	1.139	35601 Y

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EPA Method 18: Determination of Gaseous Organic Compounds using Gas Chromatography

Linear Regression Calculations								
Inlet - Ethylene Oxide					Outlet - Ethylene Oxide			
Certified ppm	Average AC	Linear Regression Statistics	ppm from curve		Certified ppm	Average AC	Linear Regression Statistics	ppm from curve
2611.00	3624614	R ² M	2628.22		50.02	113536	R ² M	48.24
1305.50	1750324	0.9995 0.0007251	1269.17		25.01	62958	0.9996 0.0004248	26.75
50.02	87617		63.53		12.51	35601		15.12



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Inlet - Quality Assurance Inlet										
Inlet Line Loss Check (Low-level calibration gas to the sample probe)										
Cpd ID	Conc. (ppm)	Inj. 1 RT	Sig.20018 AC	Inj. 2 RT	Sig.20019 AC	Inj. 3 RT	Sig.20020 AC	Average RT	AC	ppm
Ethylene Oxide	50.02	1.688	81134	1.69	84367	1.691	82315	1.690	82606	59.90
Inlet Post Test Calibration Check (mid-level calibration gas to the gas sampling valve)										
Cpd ID	Conc. (ppm)	Inj. 1 RT	AC	Inj. 2 RT	AC	Inj. 3 RT	AC	Average RT	AC	ppm
Ethylene Oxide	1305.50	1.712	1908774.7	1.712	1906249.7	1.71	1906367.9	1.711	1907131	1382.87
Outlet - Quality Assurance										
Outlet Line Loss Check (Low-level calibration gas to the sample probe)										
Cpd ID	Conc. (ppm)	Inj. 1 RT	Sig.20018 AC	Inj. 2 RT	Sig.20019 AC	Inj. 3 RT	Sig.20020 AC	Average RT	AC	ppm
Ethylene Oxide	50.02	1.142	103320	1.143	102339	1.143	102598	1.143	102752	43.65
Outlet Post Test Calibration Check (mid-level calibration gas to the gas sampling valve)										
Cpd ID	Conc. (ppm)	Inj. 1 RT	AC	Inj. 2 RT	AC	Inj. 3 RT	AC	Average RT	AC	ppm
Ethylene Oxide	25.01	1.156	56894.7	1.155	57883.3	1.154	57330.7	1.155	57370	24.37
Outlet - Unspiked Bag										
Cpd ID	Conc. (ppm)	Inj. 1 RT	AC	Inj. 2 RT	AC	Inj. 3 RT	AC	Average RT	AC	ppm
Ethylene Oxide	Unkown	0.156	400.0	0.156	400	0.156	400	0.156	400	0.17
Pre Test Spike Check (50:50 high-level calibration gas and Unspiked Bag)										
Cpd ID	Target Conc. (ppm)	Inj. 1 RT	Sig. 20021 AC	Inj. 2 RT	Sig. 20022 AC	Inj. 3 RT	Sig. 20023 AC	Average RT	AC	ppm
Ethylene Oxide	25.09	1.153	57708.7	1.154	57189.7	1.153	57552.6	1.153	57484	24.42

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EPA Method 18: Determination of Gaseous Organic Compounds using Gas Chromatography

Inlet - Sample Analysis											
Run 1											
Cpd	Inj. 1		Inj. 2		Inj. 3		Inj. 4		Inj. 5		Average
ID	RT	AC	ppm								
Ethylene Oxide	1.712	1835115	1.713	1796307	1.715	1675730.5	1.716	1682301.6	1.716	1677760.2	1.714 1733443 1256.92
Run 2											
Cpd	Inj. 1		Inj. 2		Inj. 3		Inj. 4		Inj. 5		
ID	RT	AC	ppm								
Ethylene Oxide	1.716	1765205.2	1.716	1658273.7	1.717	1736297	1.717	1723867.3	1.721	1648221.4	1.717 1706373 1237.30
Run 3											
Cpd	Inj. 1		Inj. 2		Inj. 3		Inj. 4		Inj. 5		Average
ID	RT	AC	ppm								
Ethylene Oxide	1.721	1622399.8	1.718	1625836.5	1.718	1634806.9	1.717	1632894	1.715	1542589.4	1.718 1611705 1168.65
Outlet - Sample Analysis											
Run 1											
Cpd	Inj. 1		Inj. 2		Inj. 3		Inj. 4		Inj. 5		Average
ID	RT	AC	ppm								
Ethylene Oxide	1.138	400	1.138	400	1.138	400	1.138	400.0	1.138	400.0	1.138 400 0.17
Run 2											
Cpd	Inj. 1		Inj. 2		Inj. 3		Inj. 4		Inj. 5		Average
ID	RT	AC	ppm								
Ethylene Oxide	1.138	400	1.138	400	1.138	400	1.138	400.0	1.138	400.0	1.138 400 0.17
Run 3											
Cpd	Inj. 1		Inj. 2		Inj. 3		Inj. 4		Inj. 5		Average
ID	RT	AC	ppm								
Ethylene Oxide	1.138	400	1.138	400	1.138	400	1.138	400.0	1.138	400.0	1.138 400 0.17

Detection limit set at 400 area count.

Sample Calculations

**Becton-Dickinson Medical
Sandy, Utah
Catalytic Oxidizer - Outlet
8/2/2017 - Run 1**

EPA Methods 1-4: Determination of Stack Gas Velocity and Volumetric Flow Rate

Sample Calculations

$$\begin{aligned}\text{sample volume (scf)} &= \frac{17.64 * V_M * Y_D * \{P_B + \Delta H / 13.6\}}{T_M + 460} \\ &= \frac{17.64 * 38.975 * 1}{83 + 460} * \{ 25.60 + 1.0 / 13.6 \} \\ &= 32.534\end{aligned}$$

$$\begin{aligned}\text{moisture volume (scf)} &= 0.04715 * V_{LC} \\ &= 0.04715 * 15.4 \\ &= 0.725\end{aligned}$$

$$\begin{aligned}\text{moisture content (\% / 100)} &= \frac{V_{W(STD)}}{(V_{M(STD)} + V_{W(STD)})} \\ &= \frac{0.725}{(32.534 + 0.725)} \\ &= 0.022\end{aligned}$$

$$\begin{aligned}\text{molecular weight, dry (grams/mol)} &= (0.440) * (\%CO_2) + (0.320) * (\%O_2) + (0.280) * (\%N_2 + \%CO) \\ &= (0.440) * 0.0 + (0.320) * 20.9 + (0.280) * (79.1 + 0.0) \\ &= 29.00 \quad \text{Method 2 Assumption}\end{aligned}$$

$$\begin{aligned}\text{molecular weight, actual (grams/mol)} &= M_D * (1 - B_{ws}) + (18.0) * B_{ws} \\ &= 29.00 * (1 - 0.022) + (18 * 0.022) \\ &= 28.76\end{aligned}$$

Becton-Dickinson Medical
 Sandy, Utah
 Catalytic Oxidizer - Outlet
 8/2/2017 - Run 1

EPA Methods 1-4: Determination of Stack Gas Velocity and Volumetric Flow Rate

Sample Calculations (continued)

$$\begin{aligned}
 \text{gas velocity (ft/sec)} &= 85.49 * C_p * \sqrt{\Delta P_{AVG}} * \sqrt{\frac{T_s + 460}{[P_b + P_s / 13.6] * M_a}} \\
 &= (85.49) * 0.814 * 0.6183 * \sqrt{\frac{173 + 460}{\left[\frac{25.60 + -0.20}{13.6}\right] * 28.76}} \\
 &= 39.9 \\
 \text{gas flow (acfpm)} &= 60 * \frac{\pi * (D_s / 12)^2}{4} * V_s \\
 &= 60 * \frac{\pi * (23.5 / 12)^2}{4} * 39.9 \\
 &= 7,213 \\
 \text{gas flow (dscfm)} &= 60 * V_s * (1 - B_{ws}) * \frac{\pi * (D_s / 12)^2}{4} * \frac{T_{std} * [P_b + P_s / 13.6]}{(T_s + 460) * P_{std}} \\
 &= 60 * 39.9 * (1 - 0.022) * \frac{\pi * (23.5 / 12)^2}{4} * \frac{528 * [25.60 + -0.20 / 13.6]}{(173 + 460) * 29.92} \\
 &= 5,032
 \end{aligned}$$

**Becton-Dickinson Medical
Sandy, Utah
Catalytic Oxidizer - Outlet
8/2/2017 - Run 1**

EPA Methods 1-4: Determination of Stack Gas Velocity and Volumetric Flow Rate

Variables and Abbreviations

B_{WS} - moisture content of the gas (wet volume percent/100)

%CO - carbon monoxide content of the gas (dry volume percent)

%CO₂ - carbon dioxide content of the gas (dry volume percent)

C_P - pitot tube constant (unitless)

D_S - diameter of the stack (inches)

ΔH - pressure differential at dry gas meter exit orifice (inches water)

M_D - molecular weight of the dry gas (grams per mol)

M_A - molecular weight of the wet gas (grams per mol)

%N₂ - nitrogen content of the gas (dry volume percent)

%O₂ - oxygen content of the gas (dry volume percent)

P_{AVG} - average square root of the stack gas pitot differential pressure (inches water)

P_B - barometric pressure (inches mercury)

P_S - stack pressure relative to barometric pressure (inches water)

P_{STD} - standard pressure (29.92 inches mercury)

T_M - average dry gas meter temperature (°F)

T_S - average stack temperature (°F)

T_{STD} - standard temperature (528 °R)

V_{LC} - volume of moisture collected as a liquid (milliliters)

V_M - volume indicated on dry gas meter (uncorrected actual cubic feet)

V_{MSTD} - volume of gas through dry gas meter (corrected dry standard cubic feet)

V_S - stack gas velocity (feet per second)

V_{WSTD} - volume of moisture collected as a gas at standard conditions (standard cubic feet)

Y_D - dry gas meter calibration factor (unitless)

**Becton-Dickinson Medical
Sandy, Utah
Catalytic Oxidizer - Inlet
8/2/2017 - Run 1**

EPA Method 18: Measurement of Gaseous Organic Compounds by Gas Chromatography

Sample Calculations

$$\text{EO conc (ppmvd as C}_3\text{H}_8\text{)} = \frac{[\text{EO conc (ppmvw)}]}{(1 - B_{ws})}$$

$$= \frac{1256.9}{(1 - 0.022)}$$

$$= 1284.93$$

$$\text{EO emissions (lb/hr)} = [\text{EO (ppmvd)}] * (F_{DSCFM}) * (1.556 E-7) * (44.05)$$

$$= (1284.93) * (4,005) * (1.556 E-7) * 44.05$$

$$= 35.27$$

Variables and Abbreviations

EO - ethylen oxide

B_{WS} - moisture content of the gas (wet volume percent/100)

cal - calibrated

conc - concentration

F_{DSCFM} - gas flow (dry standard cubic feet per minute, where standard = 29.92 inches Hg and 68°F)

lb/hr - pounds per hour

ppmvw - parts per million, wet volume basis



Appendix Two: Field Data

Inlet

Inlet

Air Pollution Testing Inc. : EPA Method 2 - Pitot Traverse Datasheet											
Job # :	BD7641			Operator :	TG	KM	Stack Diameter (inches) :	23.75			
Facility :	BD Medicinal			Site :	E0	Pitot	Upstream Disturbance (feet) :	7'			
Date :	8-2-17			Points :	1 2 3 4	4.3 4.7 8.1 6.5	5 6 8.1 8.4	14.6 22.6 24.8 26.5	9 10 11 12		
Probe ID :	P-674			Start Time :	11:23			Downstream Disturbance (feet) :			
Pitot Constant :	0.814			Post Test Pitot Leak Check Good? :	Good			Schematic of Sampling Location :			
Run # :	1			Run # :	CDAS			Run # :	CDAS		
O2% :	CDAS			O2% :	CDAS			O2% :	CDAS		
H2O% :	" "			H2O% :	" "			H2O% :	" "		
Ps ("H2O) :	-7.0			Ps ("H2O) :	-7.0			Ps ("H2O) :	-7.0		
Start Time :	11:28			Start Time :	12:30			Start Time :	13:21		
Post Test Pitot Leak Check Good? :	Good			Post Test Pitot Leak Check Good? :	Good			Post Test Pitot Leak Check Good? :	Good		
Point #	Delta P	Ts	Notes	Point #	Delta P	Ts	Notes	Point #	Delta P	Ts	Notes
1	0.25	120		1	30	118		1	.27	119	
2	0.28	120		2	32	118		2	.26	119	
3	0.25	119		3	31	117		3	.27	120	
4	0.27	119		4	25	117		4	.30	120	
5	0.28	120		5	27	118		5	.28	121	
6	0.30	119		6	36	117		6	.33	121	
7	0.32	119		7	37	116		7	.32	120	
8	0.33	118		8	26	117		8	.27	120	
9-1	0.26	119		9-1	26	118		9-1	.28	120	
2	0.28	120		2	29	118		2	.28	119	
3	0.28	120		3	31	119		3	.30	119	
4	0.30	119		4	30	119		4	.28	118	
5	0.29	120		5	27	117		5	.27	118	
6	0.31	120		6	32	117		6	.29	118	
7	0.30	119		7	30	118		7	.28	119	
8	0.31	119		8	38	119		8	.31	119	
Averages :	0.5388			Averages :	119.41			Averages :	0.53644		
	119.41				117.7				119.11		

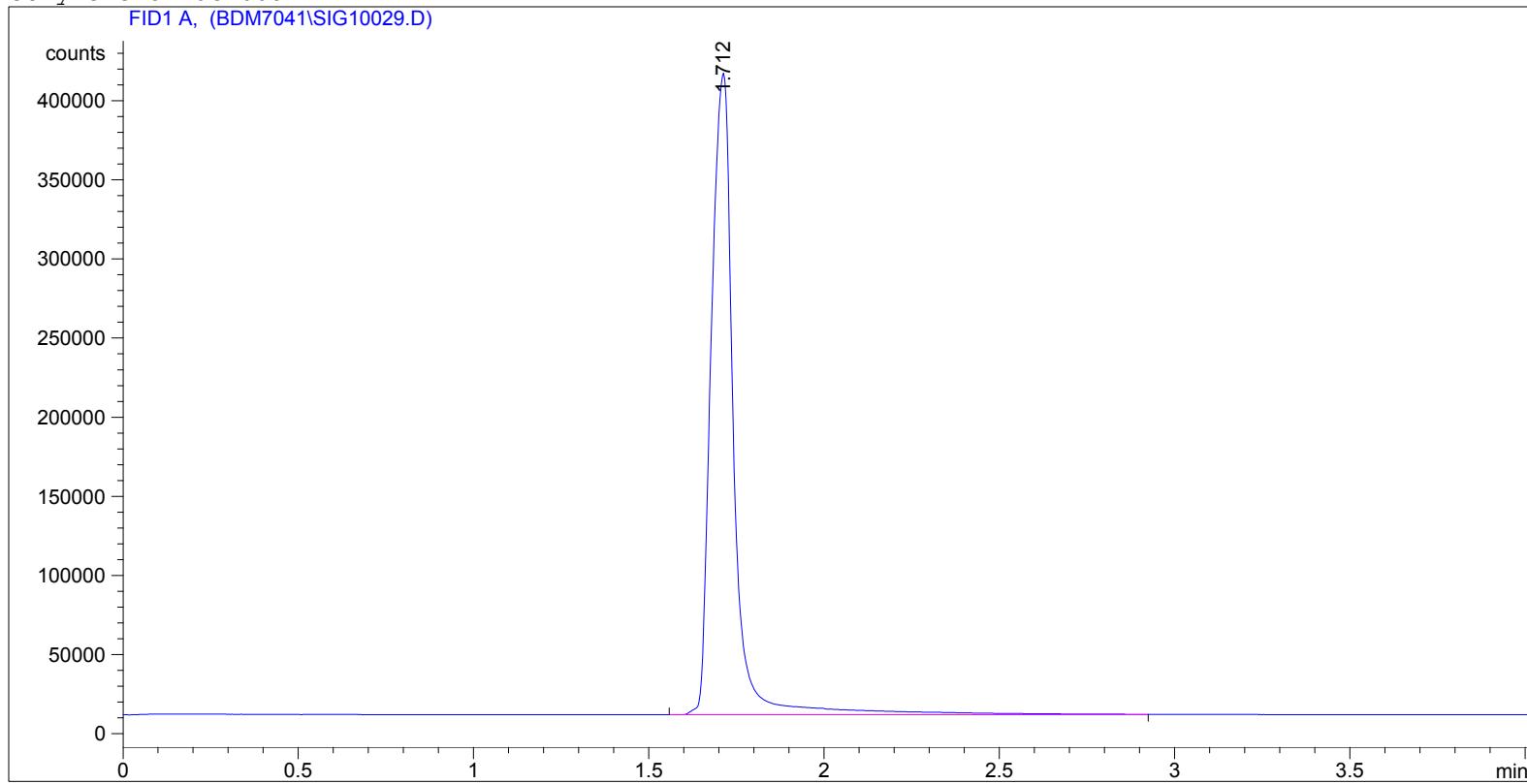
Air Pollution Testing Inc. : EPA Method 2 - Verification of Absence of Cyclonic Flow Datasheet

Job # :	BDM 7641	Operator :	KM/TG	Stack Diameter (inches) :	
Facility :	BD Medical Sandy, UT	Site :	Inlet/Outlet	Upstream Disturbance (inches) :	
Date :	8/2/17	Points :	Input 11.3 / 4.3 2 6 / 6.0 3 8.1 / 8.1 4 11.1 / 11.1 5 19.8 / 19.4 6 22.6 / 22.4	Downstream Disturbance (inches) :	
Probe ID :	P-674			Schematic of Sampling Location :	
Pitot Constant :	0.814				
Post Test Pitot Leak Check Good? :	0.000@ 5" H2O	Point #	Butt	Angle at 0.0 Delta P	Point #
Point #	Tn	Delta P at 0 degrees	Angle at 0.0 Delta P	Point #	Delta P at 0 degrees
1-1	6.04	7	1-1	0.05	3
2	0.05	4	2	0.05	3
3	0.03	3	3	0.03	2
4	0.02	4	4	0.02	3
5	0.04	5	5	0.03	2
6	0.05	6	6	0.04	4
7	0.10	8	7	0.05	3
8	0.03	6	8	0.07	6
2-1	0.04	6	2-1	0.02	2
2	0.04	3	2	0.03	2
3	0.02	5	3	0.04	4
4	0.05	7	4	0.05	7
5	0.03	6	5	0.06	8
6	0.07	8	6	0.03	3
7	0.02	2	7	0.02	5
8	0.04	4	8	0.04	5
Average Absolute Angle =	< 10°	Average Absolute Angle =	< 20°	Average Absolute Angle =	< 20°

* If the absolute average angle is greater than 20 degrees, the flow is considered non-laminar and an alternative method must be used.

Inlet Run 1 Inj 1

```
=====
Injection Date : 8/2/2017 11:05:04 AM
Sample Name : Run 1 In I1
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.712	VV	0.0718	1.83511e6	4.05660e5	1.000e2

Totals : 1.83512e6 4.05660e5

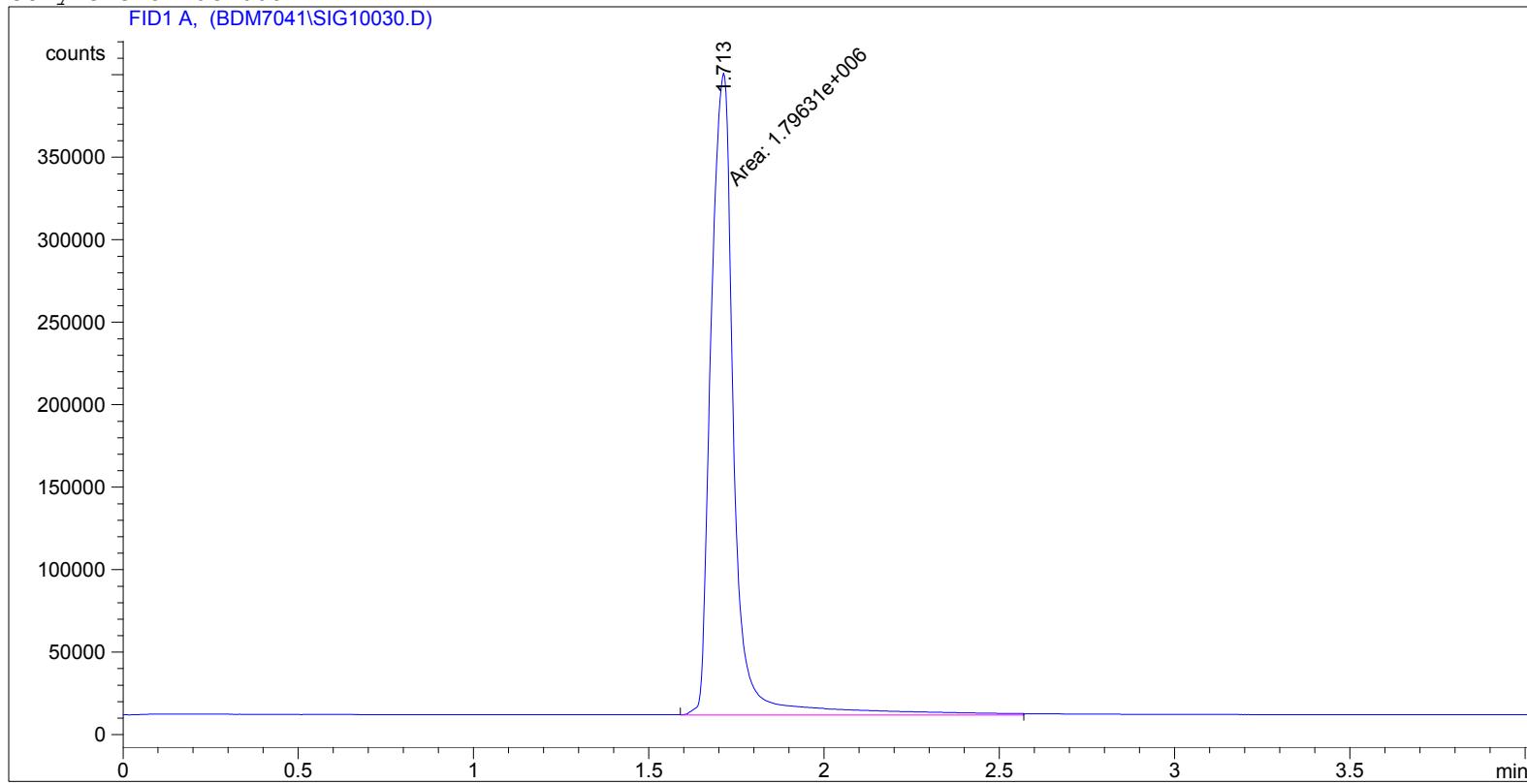
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Run 1 Inj 2

```
=====
Injection Date : 8/2/2017 11:14:49 AM
Sample Name : Run 1 In I2
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.713	MF	0.0769	1.79631e6	3.89346e5	1.000e2

Totals : 1.79631e6 3.89346e5

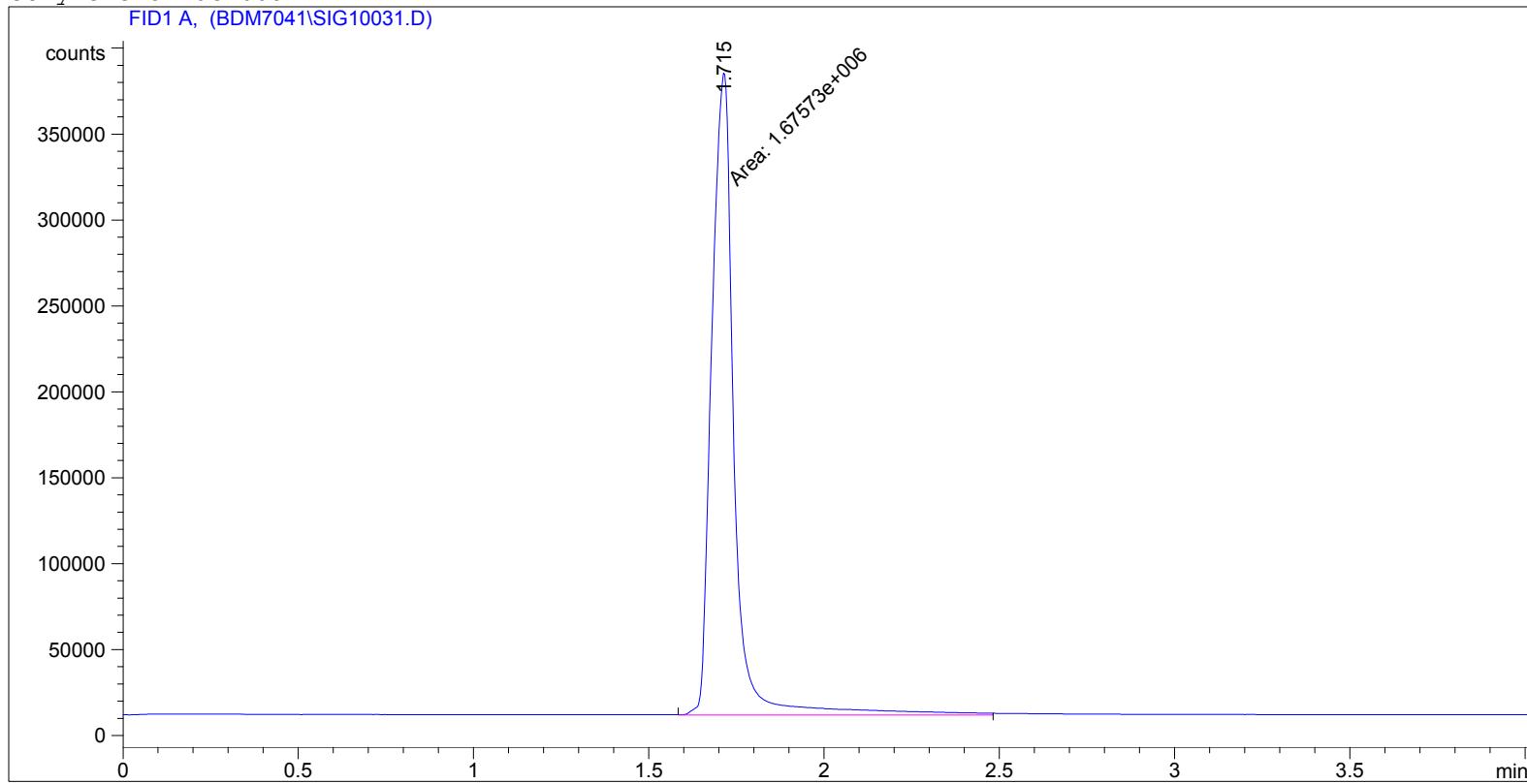
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Run 1 Inj 3

```
=====
Injection Date : 8/2/2017 11:25:44 AM
Sample Name : Run 1 In I3
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.715	MF	0.0746	1.67573e6	3.74143e5	1.000e2

Totals : 1.67573e6 3.74143e5

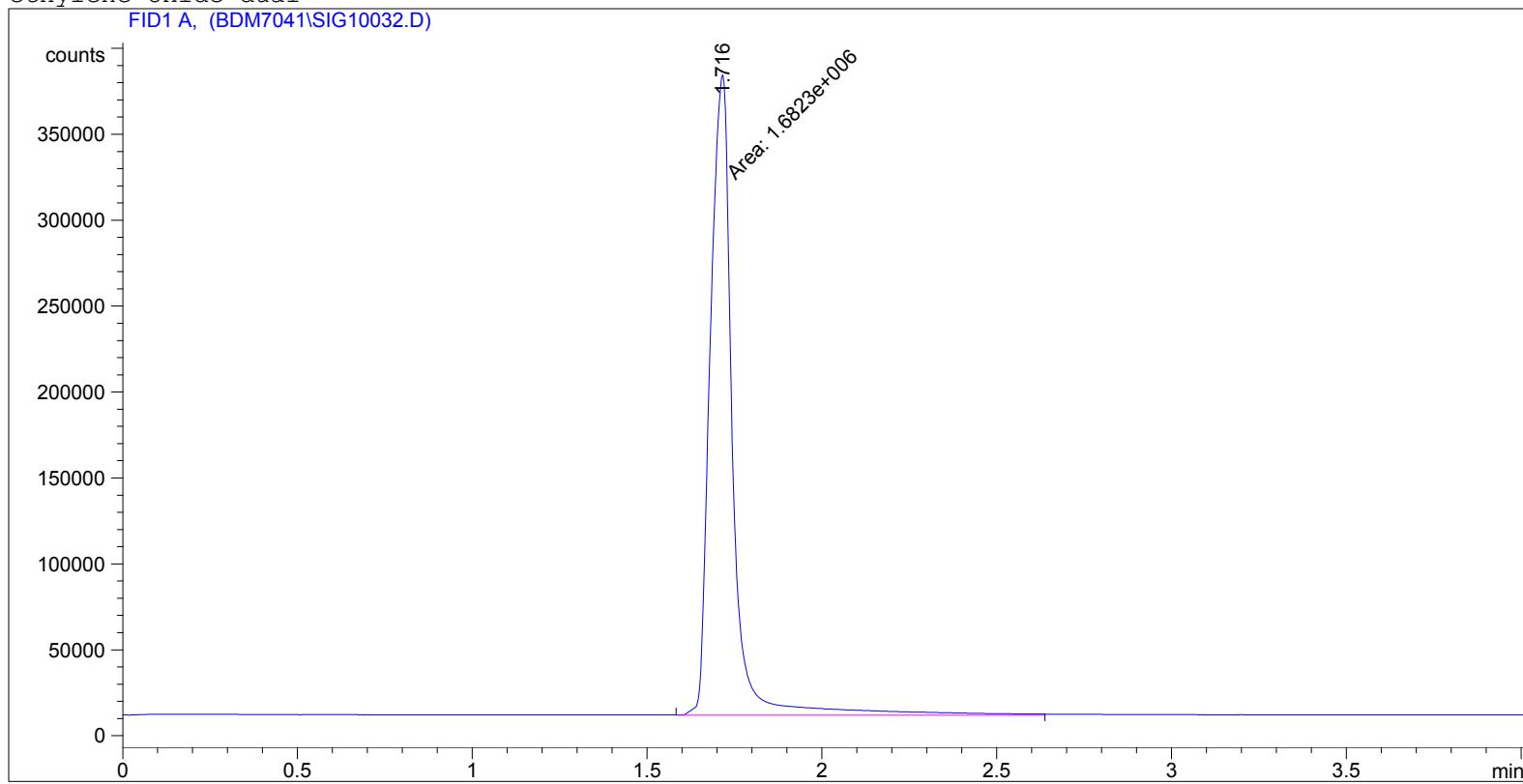
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Run 1 Inj 4

```
=====
Injection Date : 8/2/2017 11:44:12 AM
Sample Name : Run 1 In I4
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.716	MF	0.0751	1.68230e6	3.73172e5	1.000e2

Totals : 1.68230e6 3.73172e5

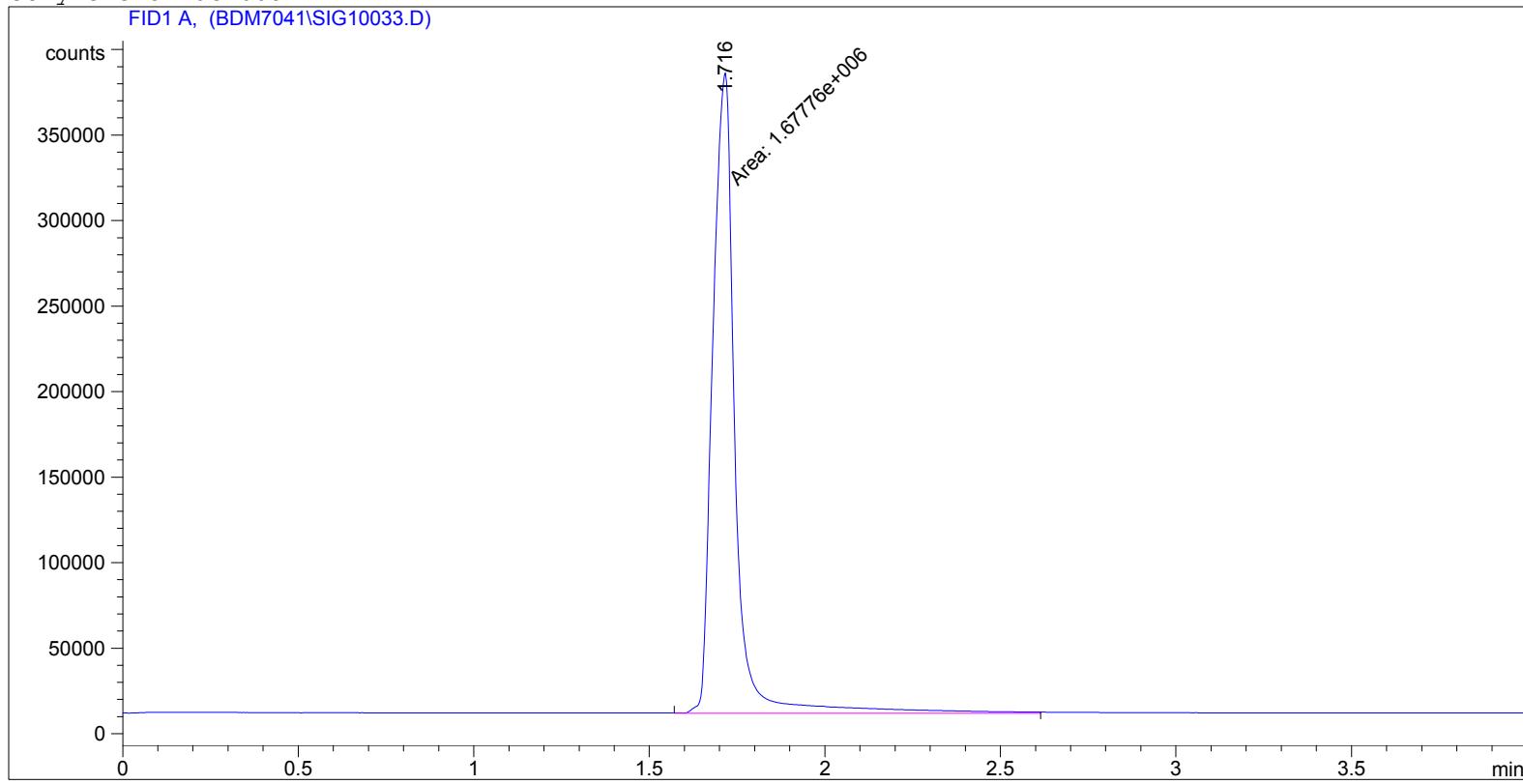
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Run 1 Inj 5

```
=====
Injection Date : 8/2/2017 11:56:45 AM
Sample Name : Run 1 In I5
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.716	MF	0.0746	1.67776e6	3.74944e5	1.000e2

Totals : 1.67776e6 3.74944e5

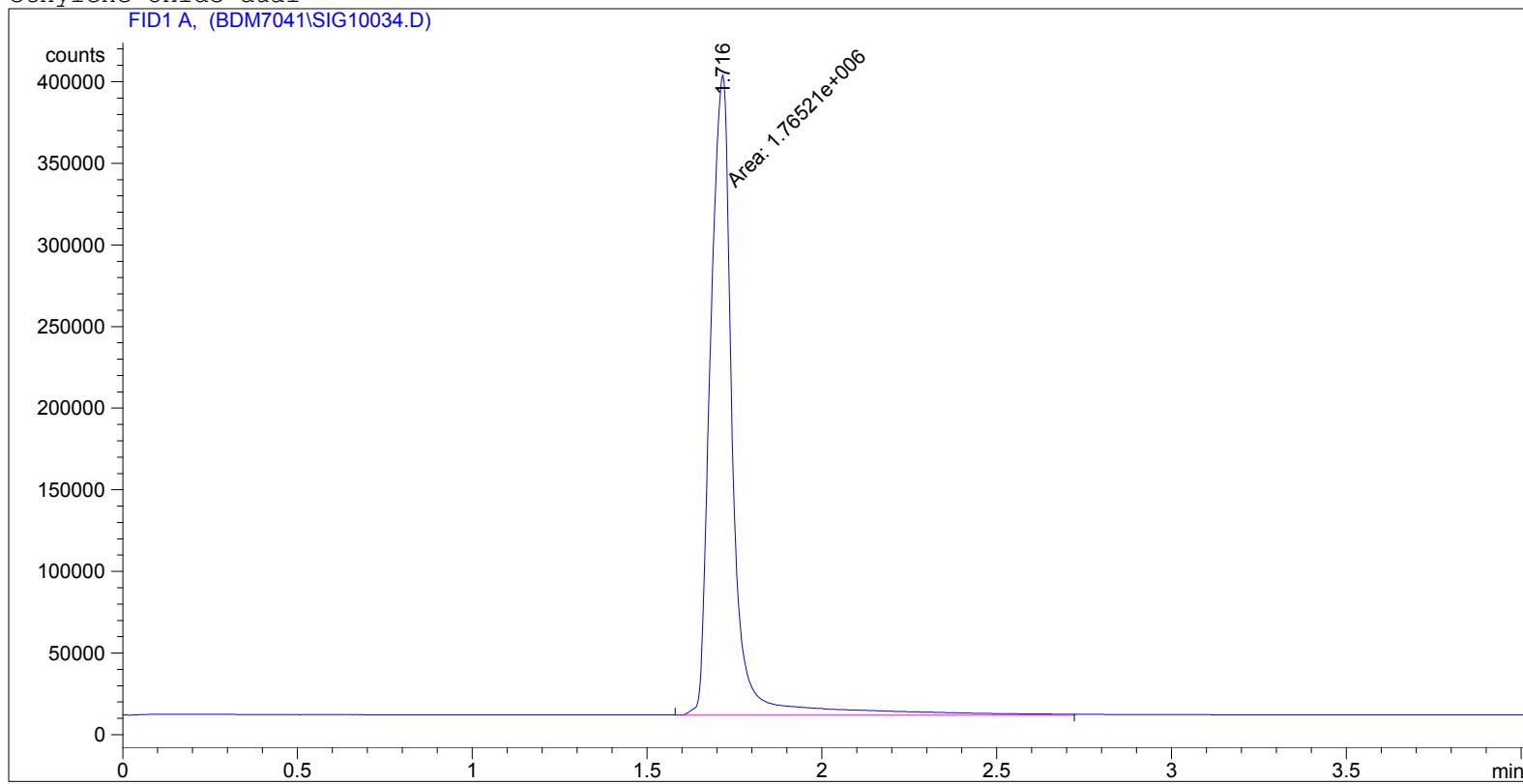
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Run 2 Inj 1

```
=====
Injection Date : 8/2/2017 12:15:28 PM
Sample Name : Run 2 In I1
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.716	MF	0.0749	1.76521e6	3.92573e5	1.000e2

Totals : 1.76521e6 3.92573e5

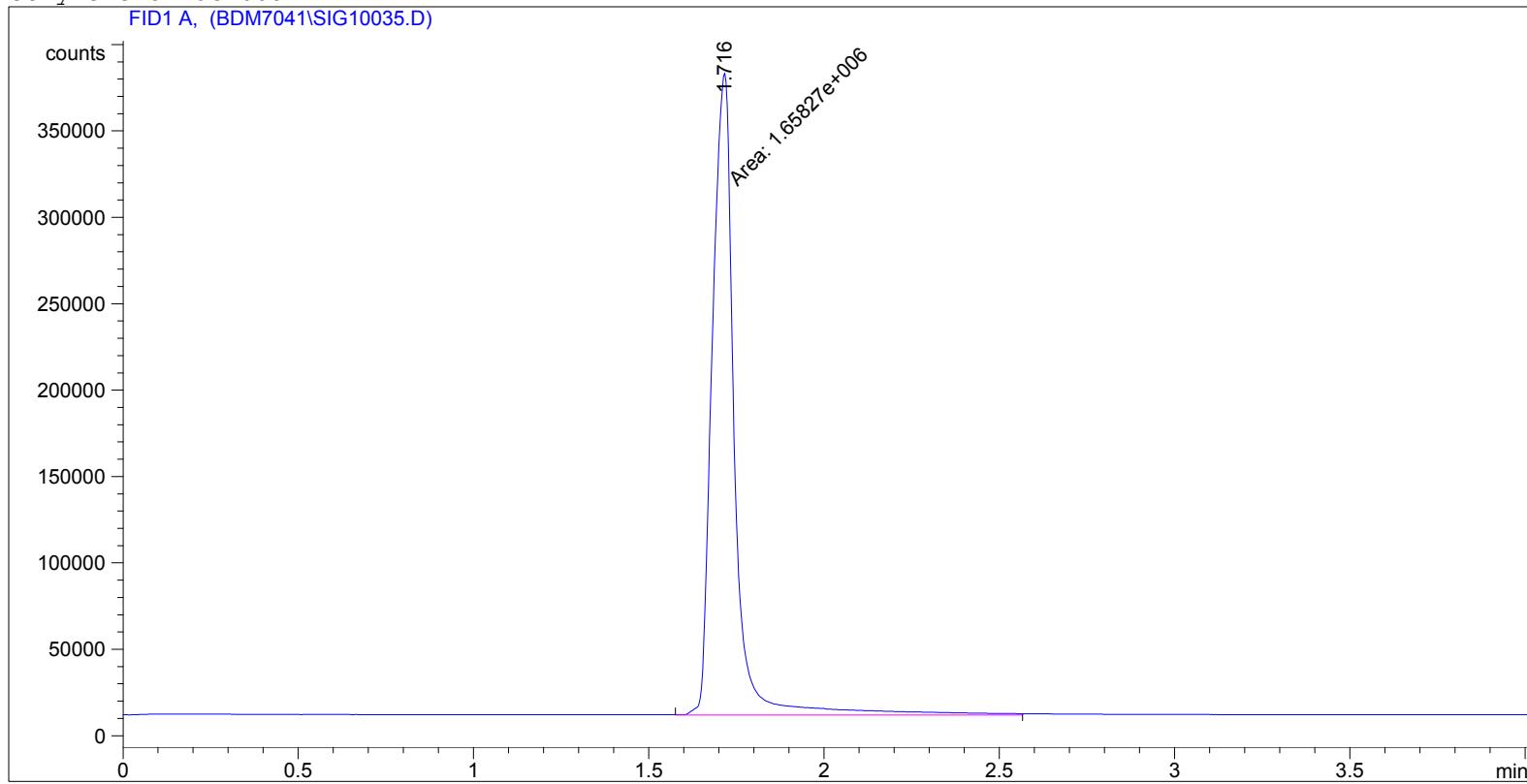
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Run 2 Inj 2

```
=====
Injection Date : 8/2/2017 12:23:29 PM
Sample Name : Run 2 In I2
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.716	MF	0.0743	1.65827e6	3.71958e5	1.000e2

Totals : 1.65827e6 3.71958e5

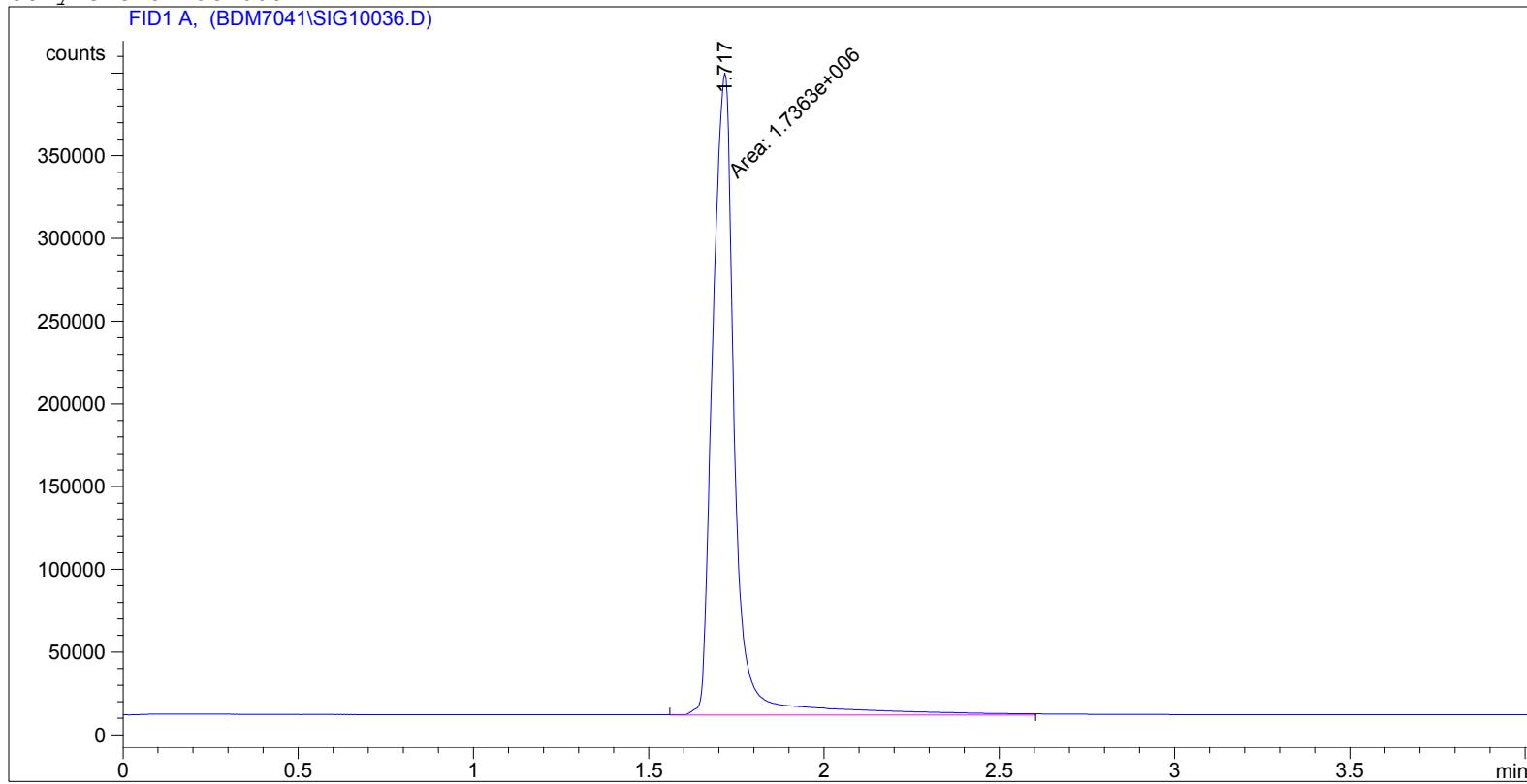
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Run 2 Inj 3

```
=====
Injection Date : 8/2/2017 12:37:50 PM
Sample Name : Run 2 In I3
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.717	MF	0.0745	1.73630e6	3.88308e5	1.000e2

Totals : 1.73630e6 3.88308e5

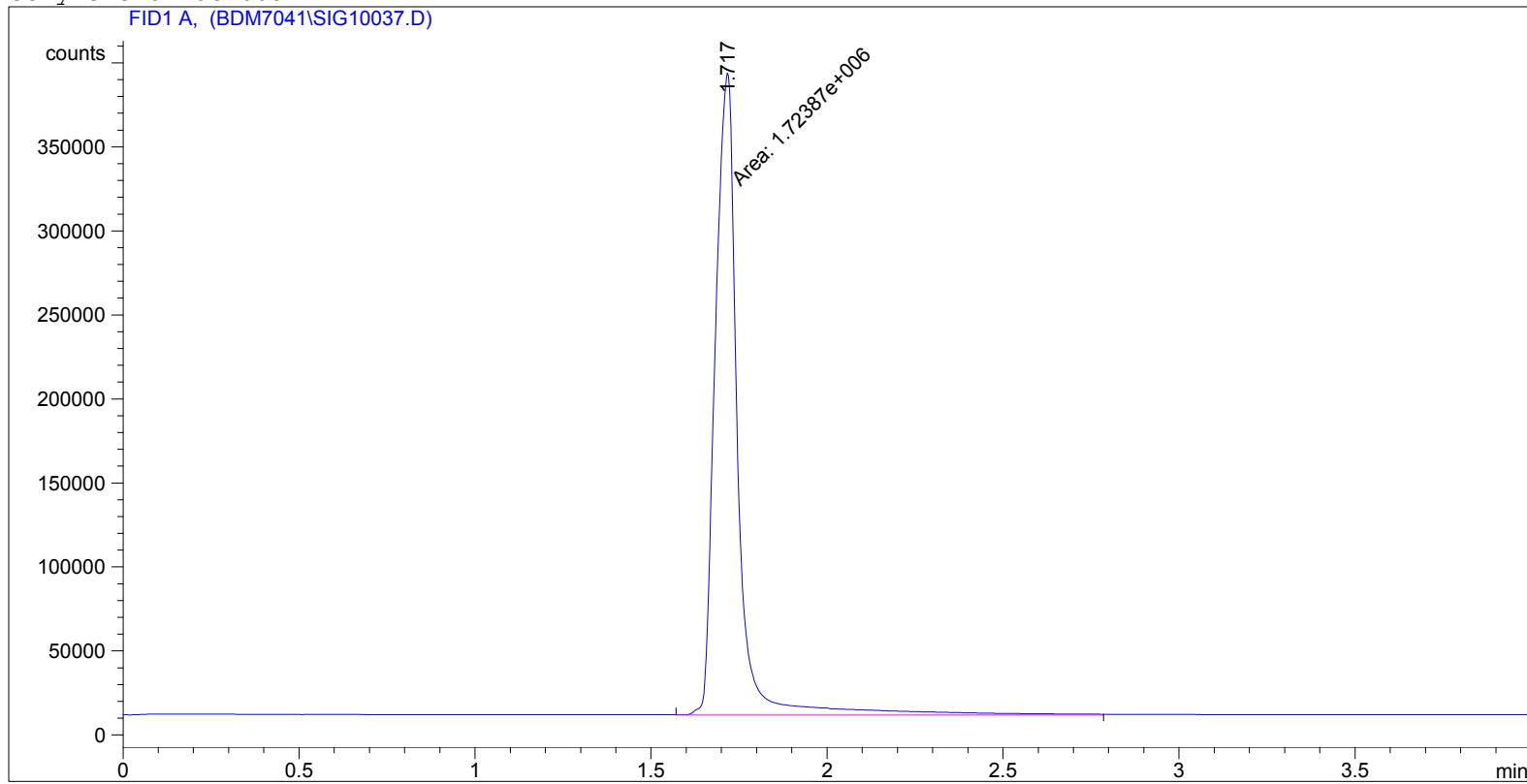
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Run 2 Inj 4

```
=====
Injection Date : 8/2/2017 12:50:36 PM
Sample Name : Run 2 In I4
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.717	MF	0.0751	1.72387e6	3.82398e5	1.000e2

Totals : 1.72387e6 3.82398e5

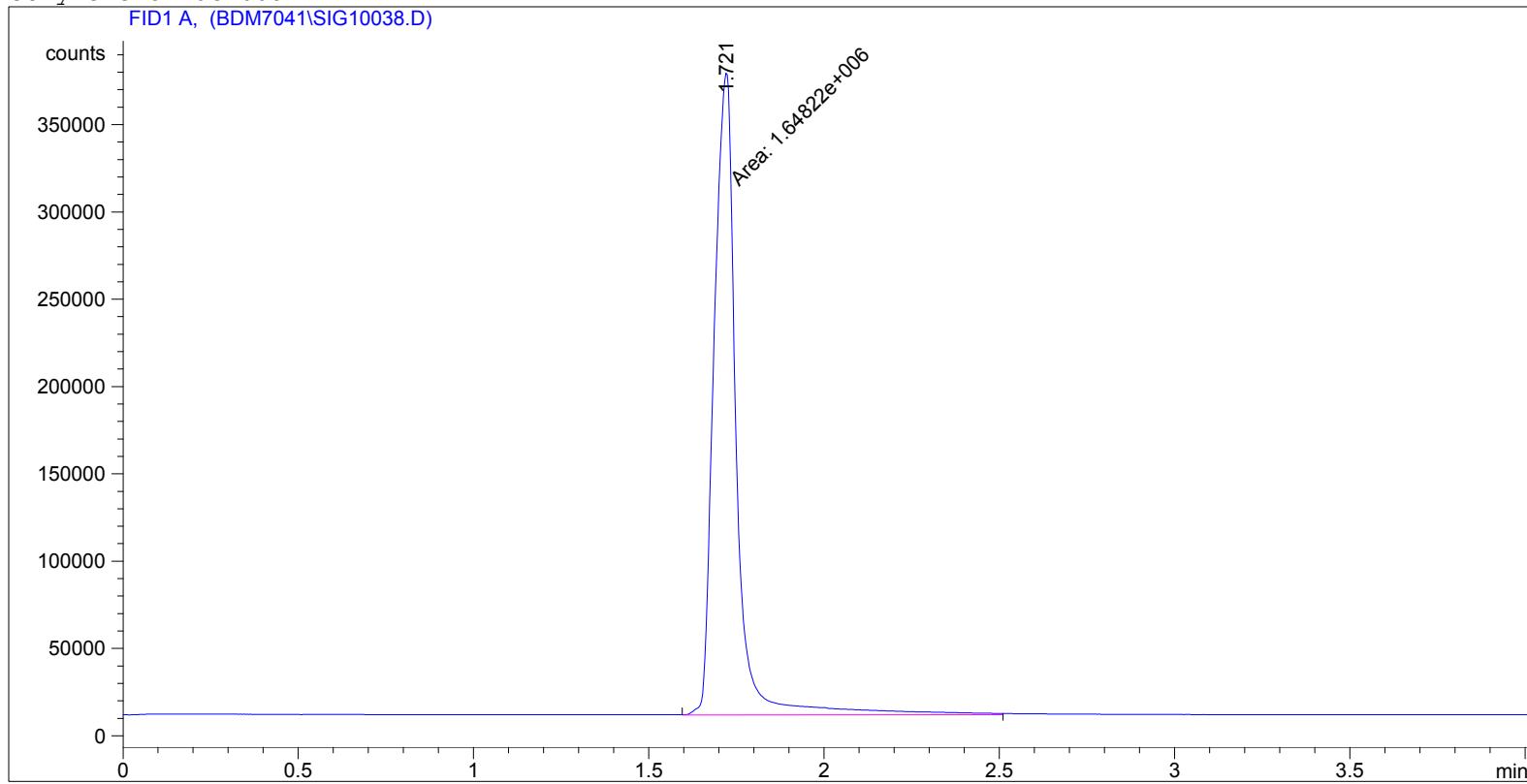
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Run 2 Inj 5

```
=====
Injection Date : 8/2/2017 1:05:15 PM
Sample Name : Run 2 In I5
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.721	MF	0.0746	1.64822e6	3.68062e5	1.000e2

Totals : 1.64822e6 3.68062e5

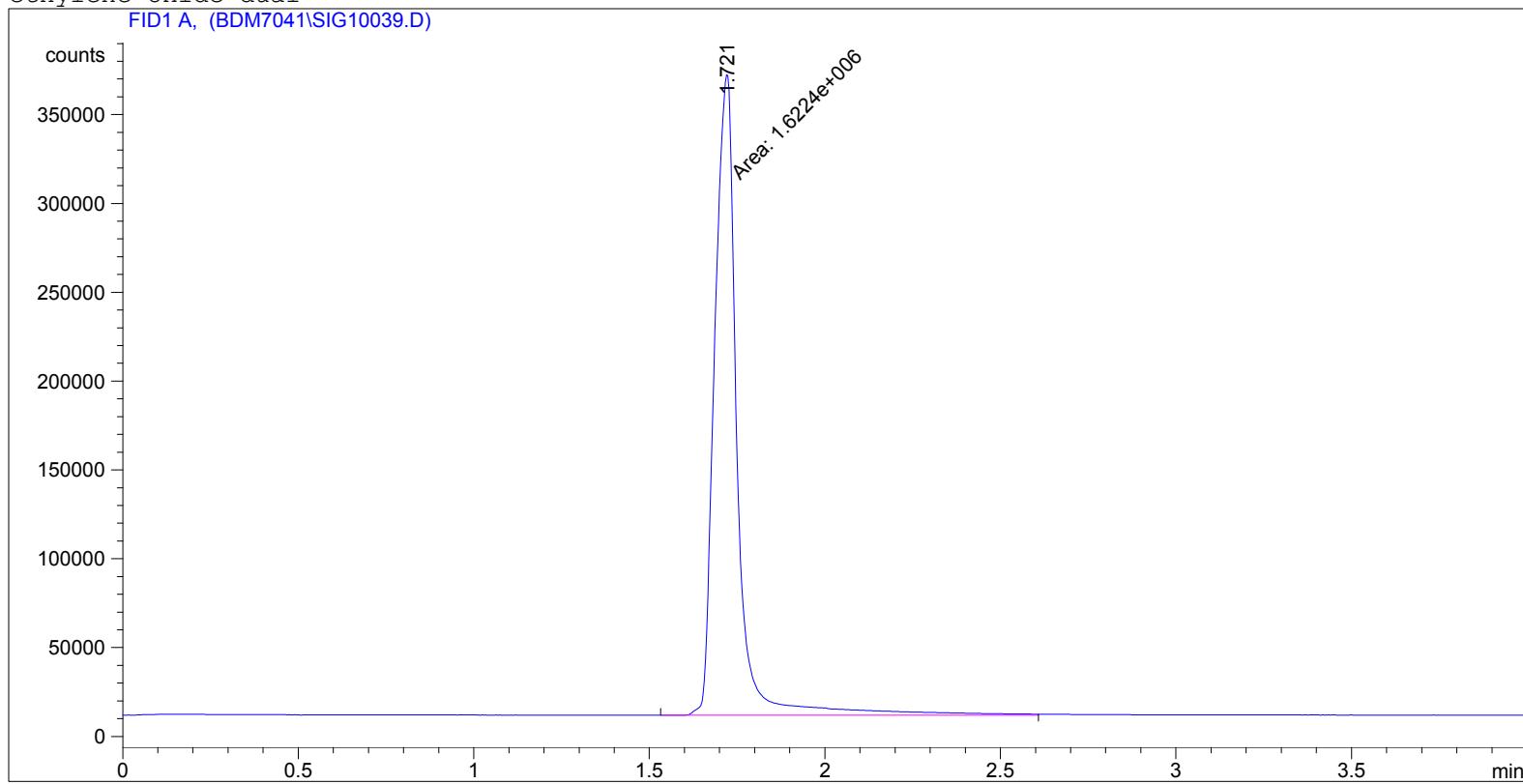
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Run 3 Inj 1

```
=====
Injection Date : 8/2/2017 1:20:35 PM
Sample Name : Run 3 In I1
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.721	MF	0.0749	1.62240e6	3.61003e5	1.000e2

Totals : 1.62240e6 3.61003e5

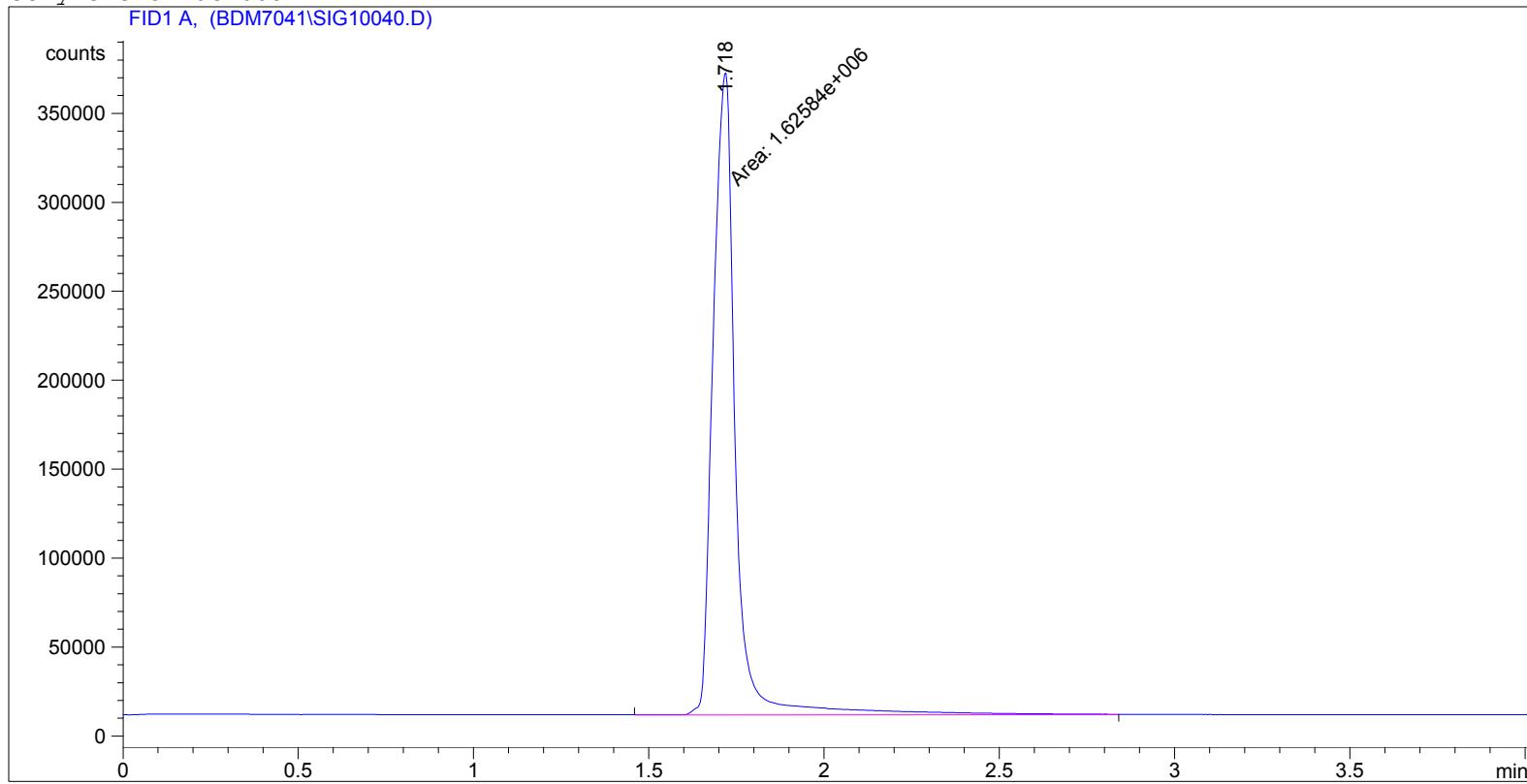
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Run 3 Inj 2

```
=====
Injection Date : 8/2/2017 1:36:09 PM
Sample Name : Run 3 In I2
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.718	MF	0.0749	1.62584e6	3.61821e5	1.000e2

Totals : 1.62584e6 3.61821e5

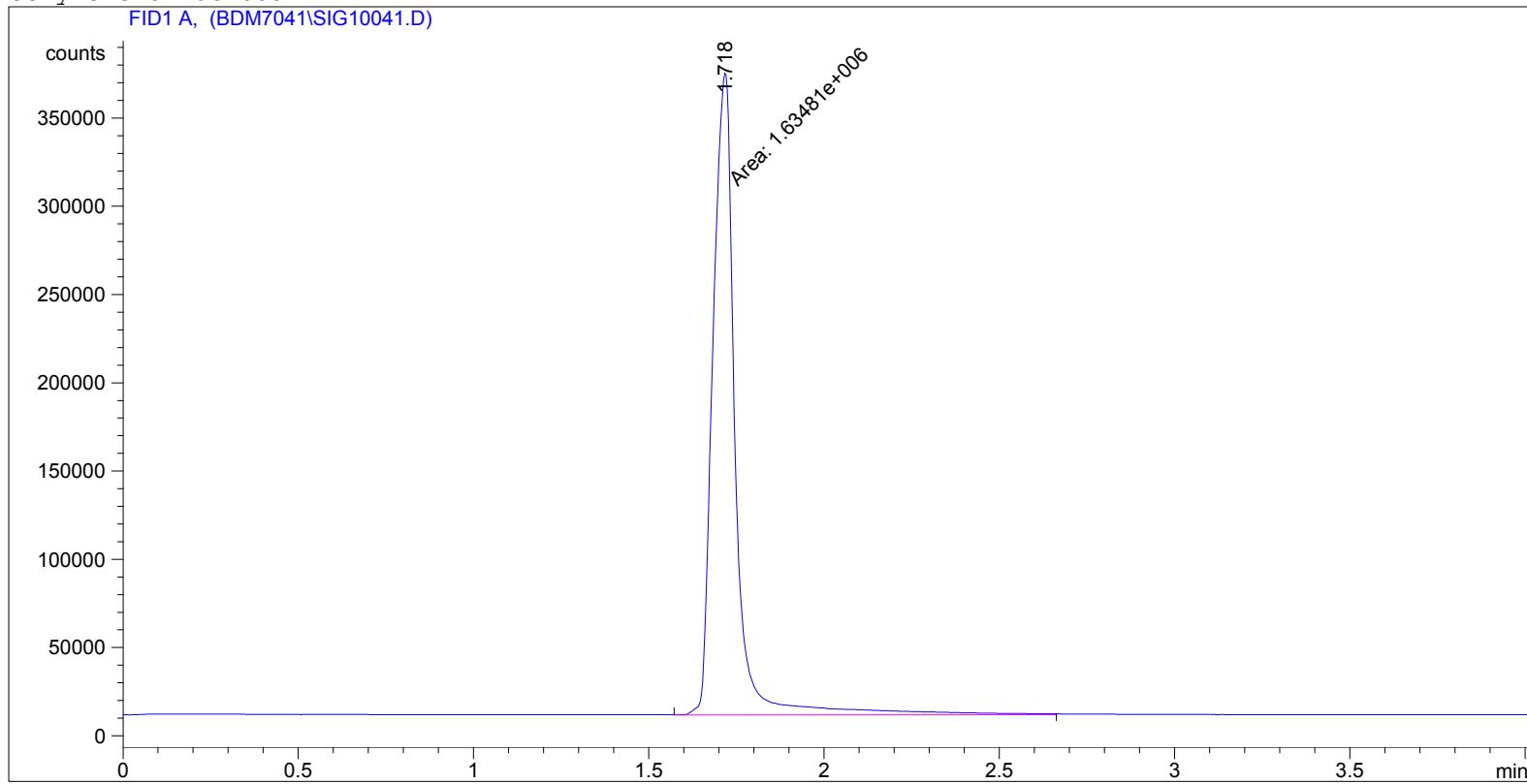
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Run 3 Inj 3

```
=====
Injection Date : 8/2/2017 1:44:29 PM
Sample Name : Run 3 In I3
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.718	MF	0.0748	1.63481e6	3.64137e5	1.000e2

Totals : 1.63481e6 3.64137e5

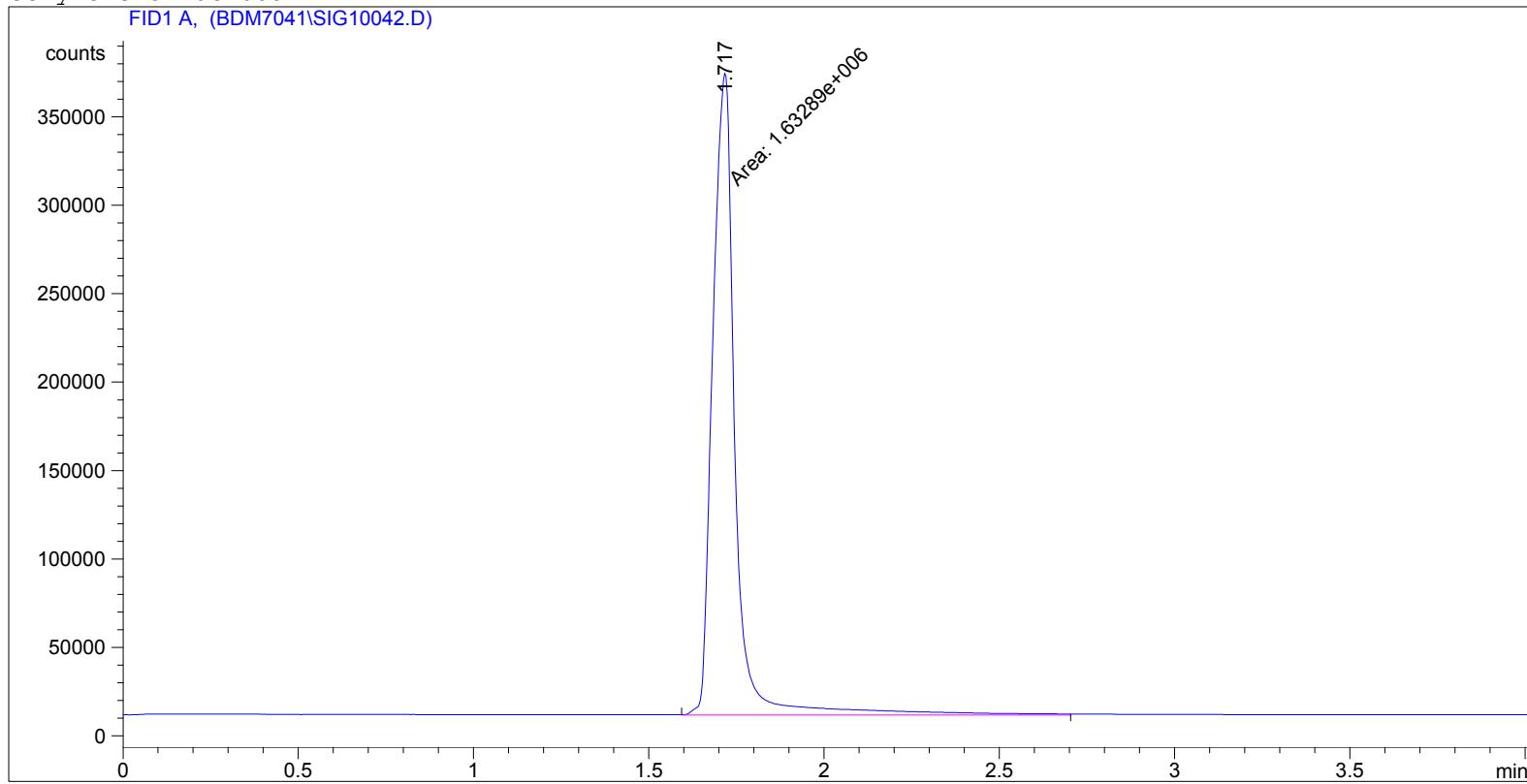
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Run 3 Inj 4

```
=====
Injection Date : 8/2/2017 1:51:47 PM
Sample Name : Run 3 In I4
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.717	MF	0.0749	1.63289e6	3.63323e5	1.000e2

Totals : 1.63289e6 3.63323e5

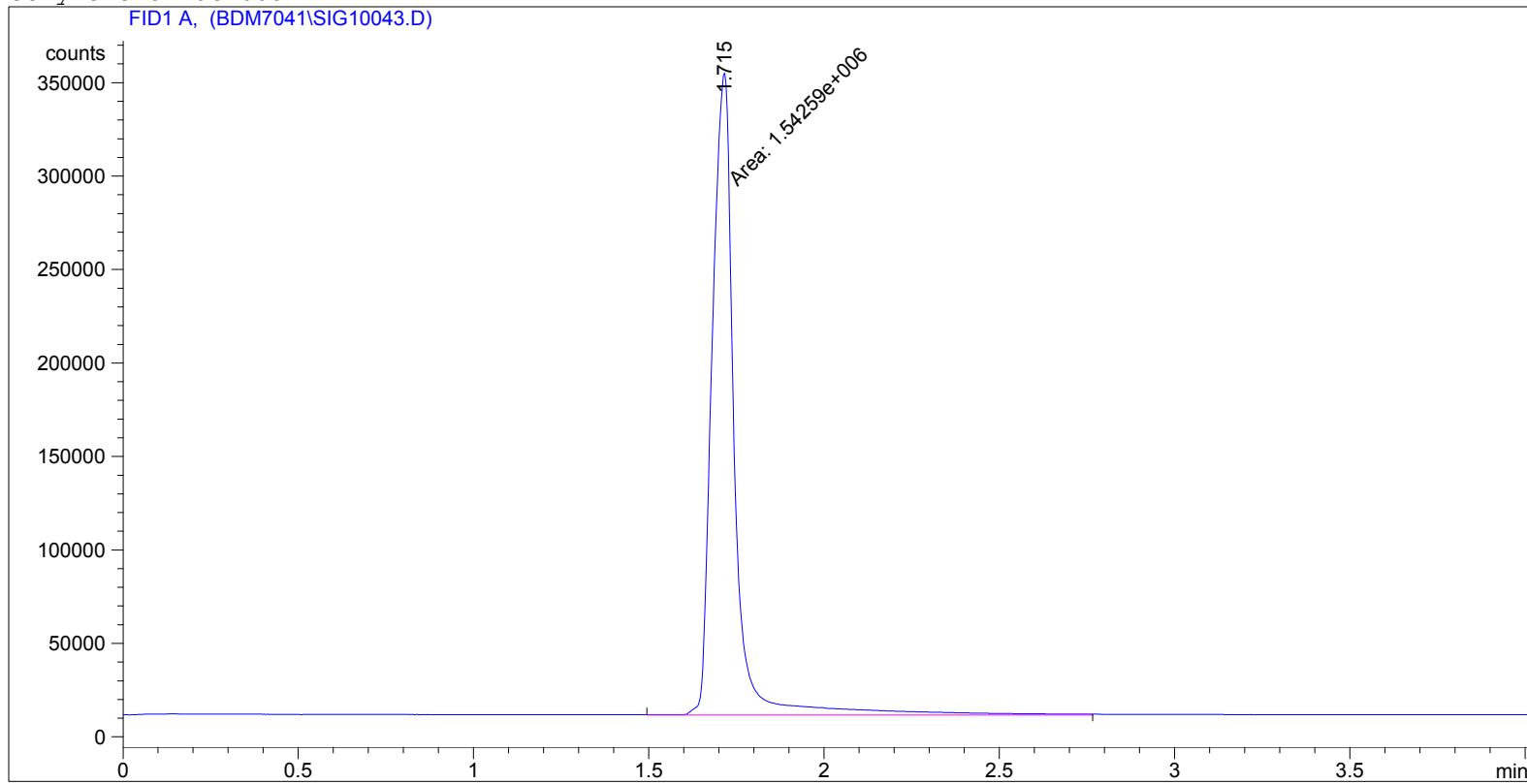
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Run 3 Inj 5

```
=====
Injection Date : 8/2/2017 2:09:02 PM
Sample Name : Run 3 In I5
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.715	MF	0.0747	1.54259e6	3.44099e5	1.000e2

Totals : 1.54259e6 3.44099e5

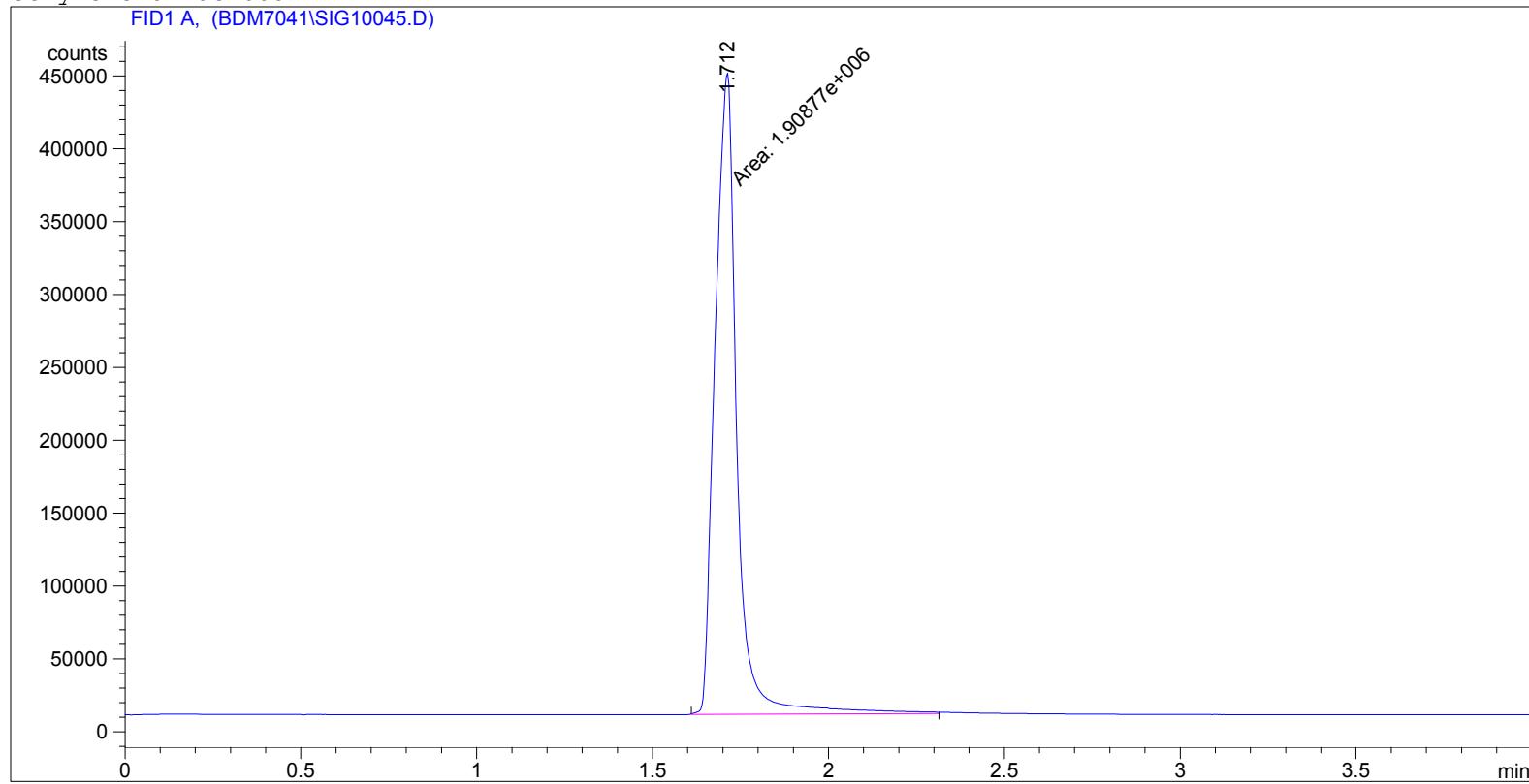
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Post Test Mid-Level Cal Check 1305.5 ppm EO Inj 1

```
=====
Injection Date : 8/2/2017 2:40:22 PM
Sample Name : In Post Cal II
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width MM	Area counts*s	Height [counts]	Area %
1	1.712	MM	0.0722	1.90877e6	4.40522e5	1.000e2

Totals : 1.90877e6 4.40522e5

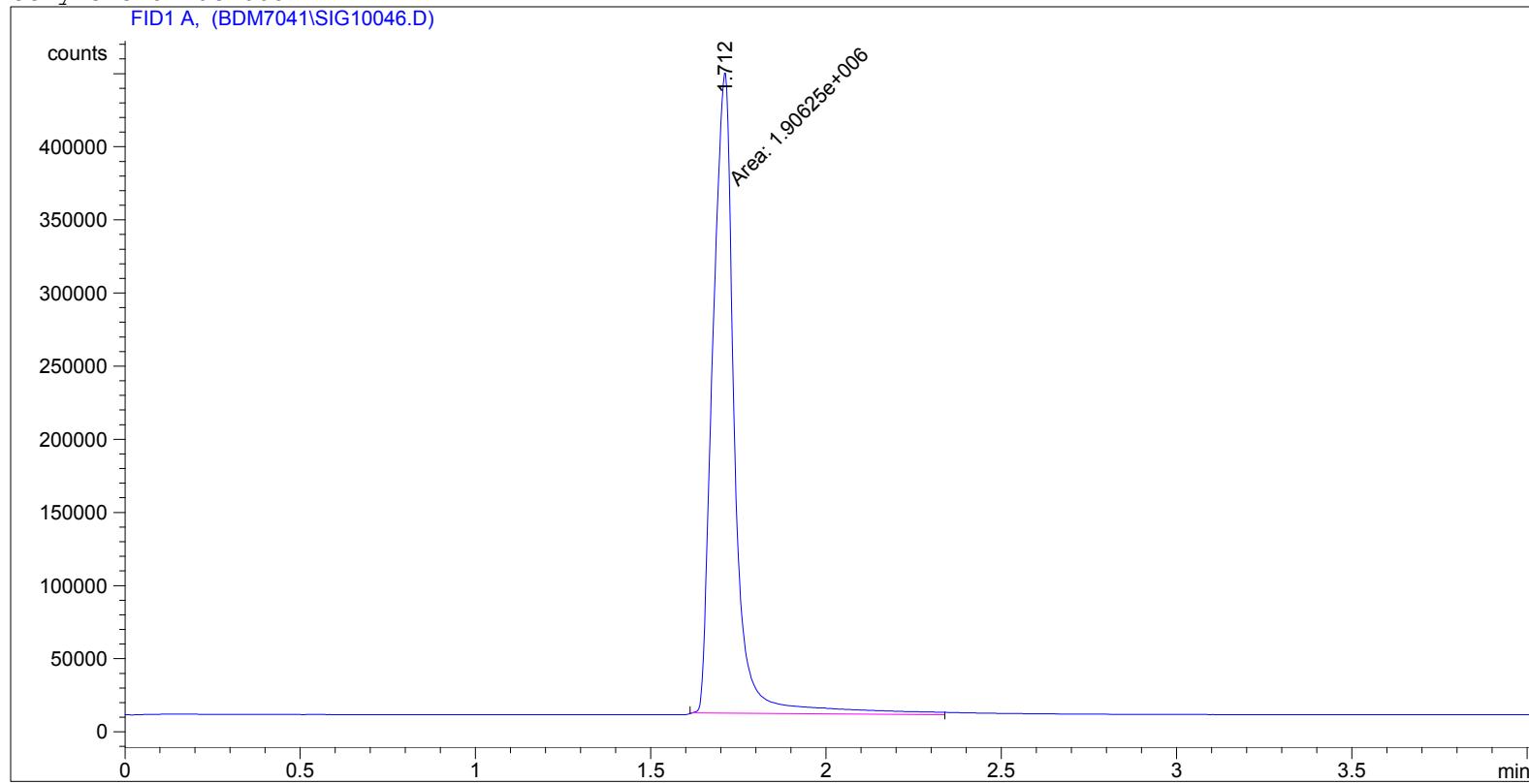
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Post Test Mid-Level Cal Check 1305.5 ppm EO Inj 2

```
=====
Injection Date : 8/2/2017 2:55:53 PM
Sample Name : In Post Cal I2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width MM	Area counts*s	Height [counts]	Area %
1	1.712	MM	0.0723	1.90625e6	4.39413e5	1.000e2

Totals : 1.90625e6 4.39413e5

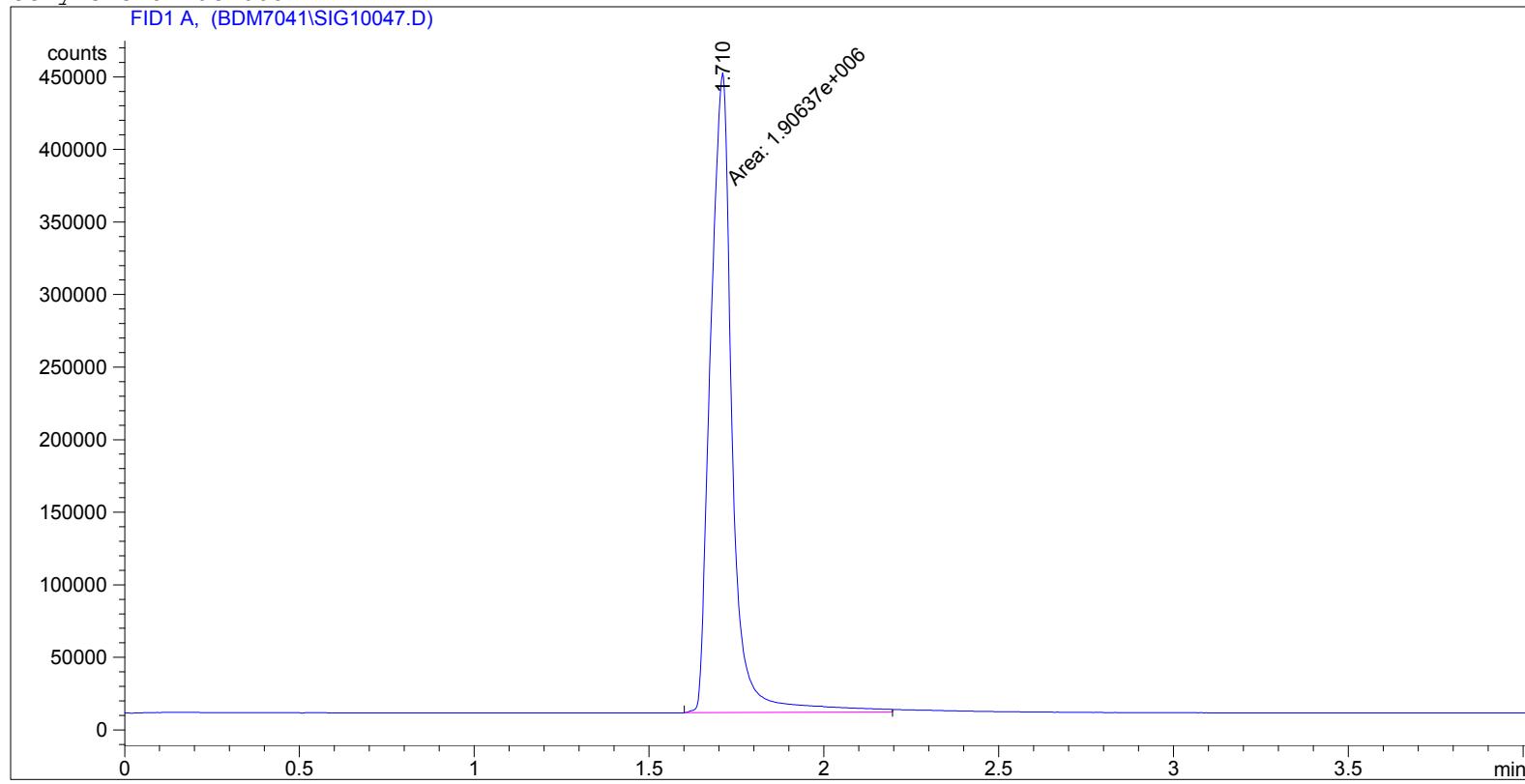
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Post Test Mid-Level Cal Check 1305.5 ppm EO Inj 3

```
=====
Injection Date : 8/2/2017 3:01:10 PM
Sample Name : In Post Cal I3
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.710	MM	0.0720	1.90637e6	4.41179e5	1.000e2

Totals : 1.90637e6 4.41179e5

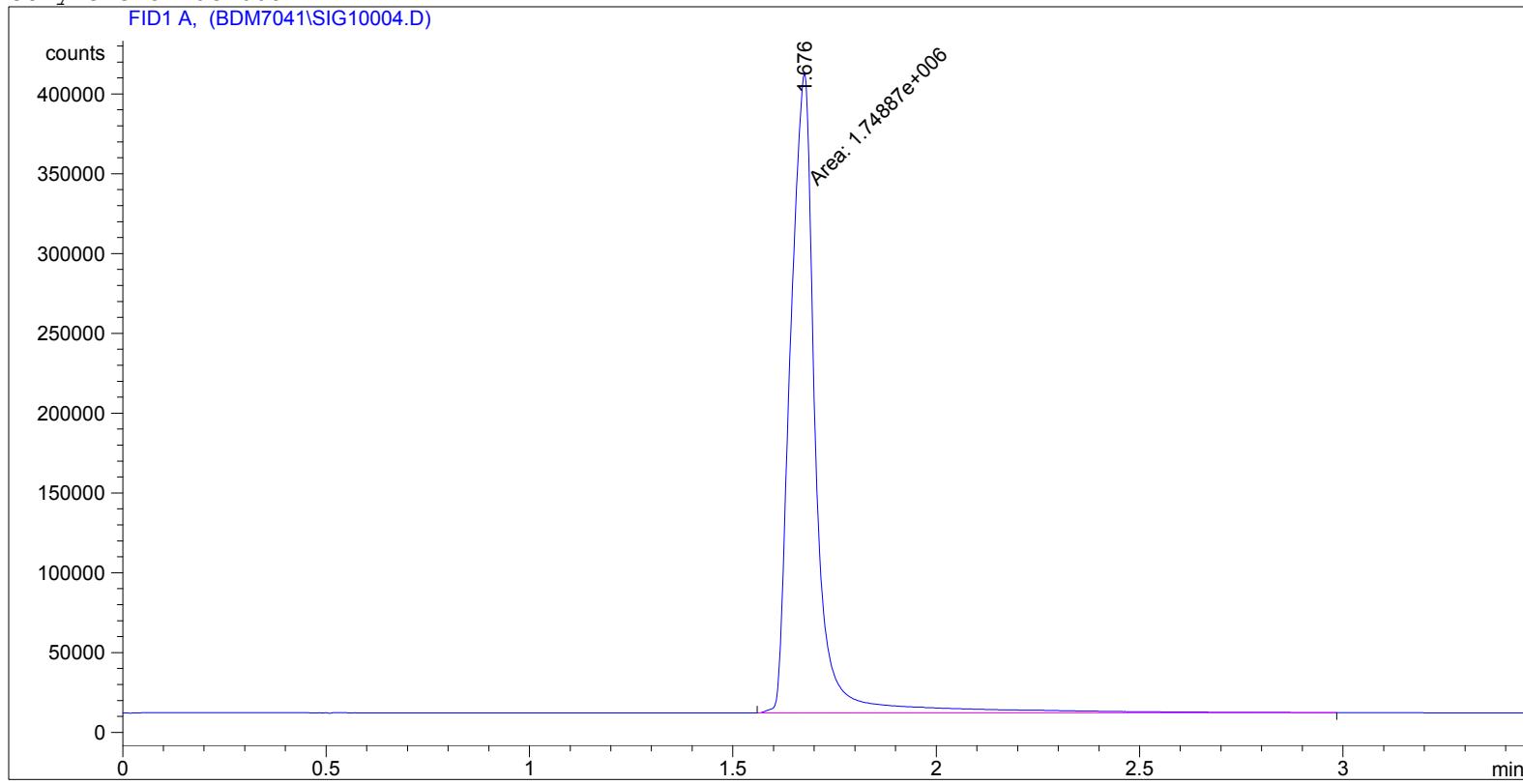
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Mid Level Cal 1305.5 EO ppm Inj 1

```
=====
Injection Date : 8/1/2017 12:55:27 PM
Sample Name : Pre 1305 Inj 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.676	MM	0.0726	1.74887e6	4.01525e5	1.000e2

Totals : 1.74887e6 4.01525e5

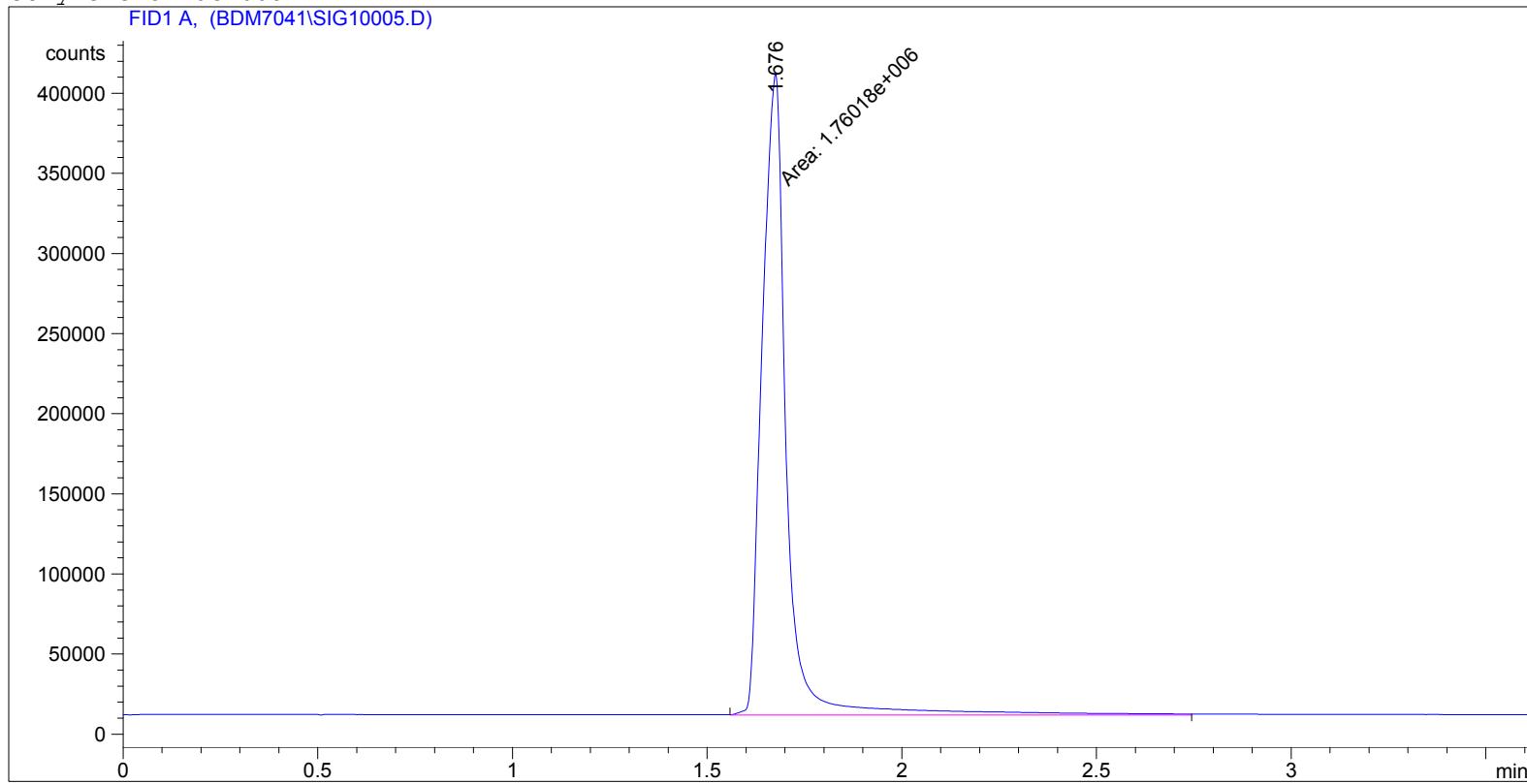
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Mid Level Cal 1305.5 EO ppm Inj 2

```
=====
Injection Date : 8/1/2017 1:05:14 PM
Sample Name : Pre 1305 Inj 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.676	MM	0.0731	1.76018e6	4.01418e5	1.000e2

Totals : 1.76018e6 4.01419e5

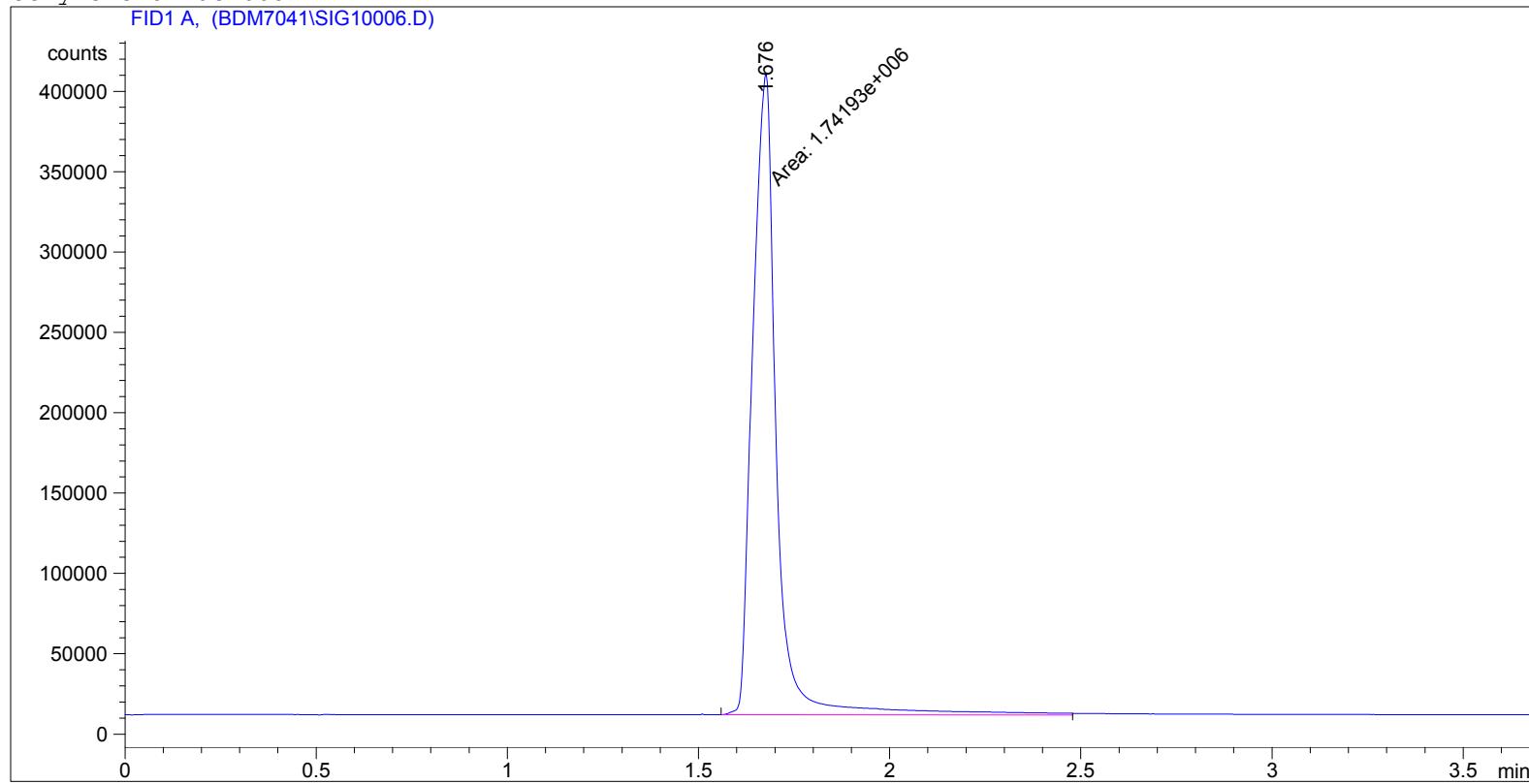
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Mid Level Cal 1305.5 EO ppm Inj 3

```
=====
Injection Date : 8/1/2017 1:14:12 PM
Sample Name : Pre 1305 Inj 3
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.676	MF	0.0726	1.74193e6	3.99768e5	1.000e2

Totals : 1.74193e6 3.99768e5

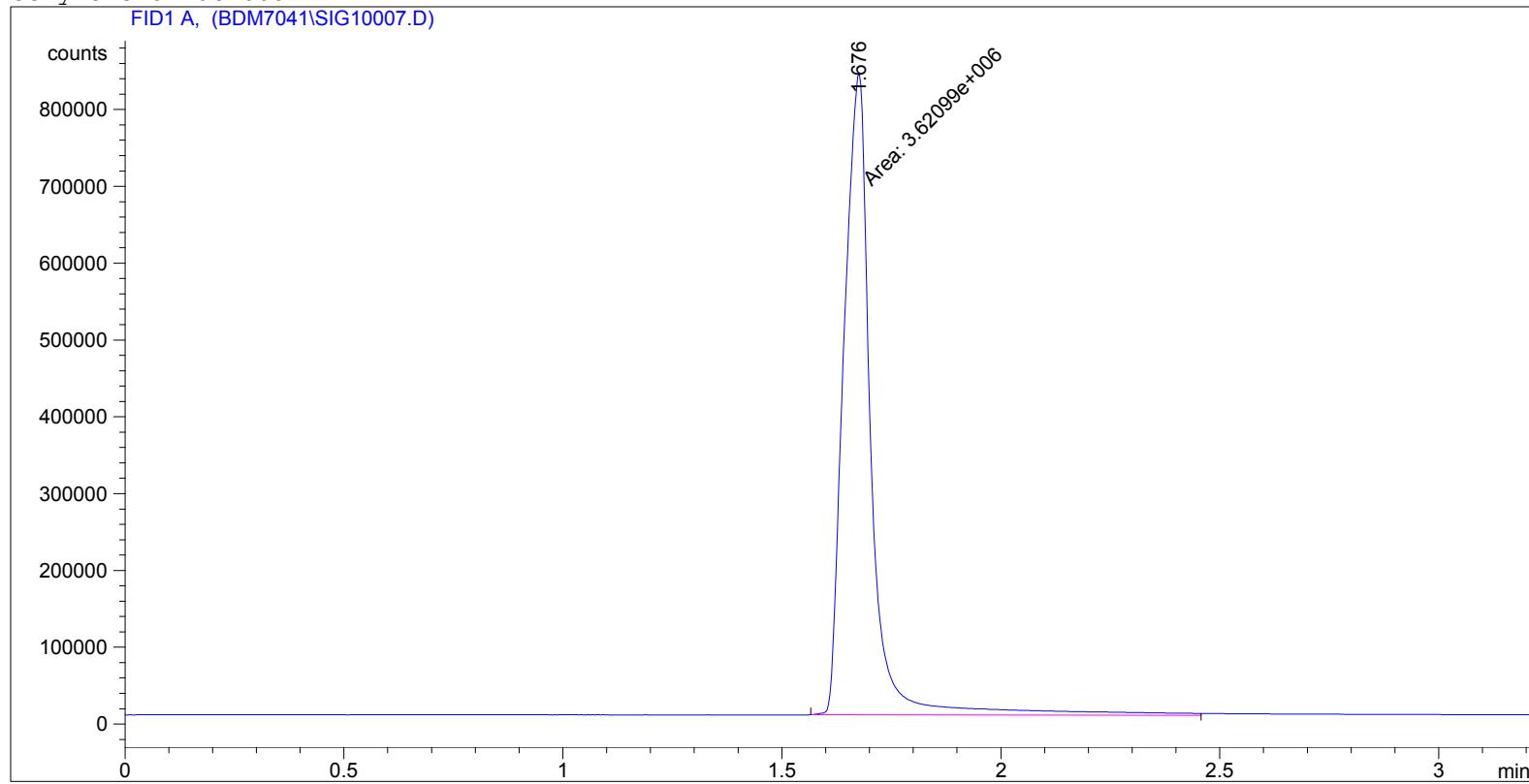
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Mid Level Cal 2611 EO ppm Inj 1

```
=====
Injection Date : 8/1/2017 1:29:11 PM
Sample Name : Pre 2611 Inj 1
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.676	MM	0.0721	3.62099e6	8.36675e5	1.000e2

Totals : 3.62099e6 8.36675e5

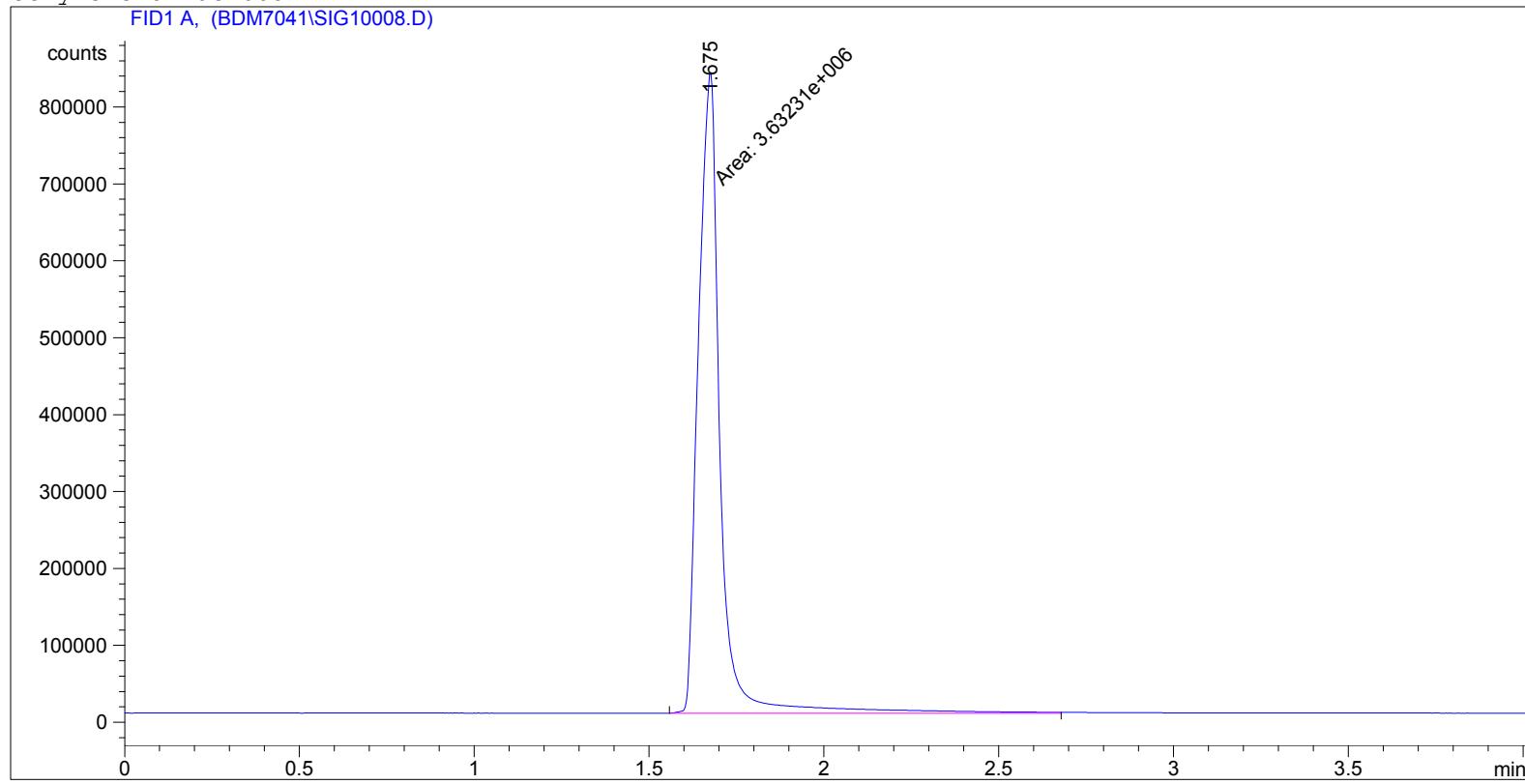
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Mid Level Cal 2611 EO ppm Inj 2

```
=====
Injection Date : 8/1/2017 1:36:35 PM
Sample Name : Pre 2611 Inj 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



===== Area Percent Report =====

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width MM	Area counts*s	Height [counts]	Area %
1	1.675	MM	0.0725	3.63231e6	8.35353e5	1.000e2

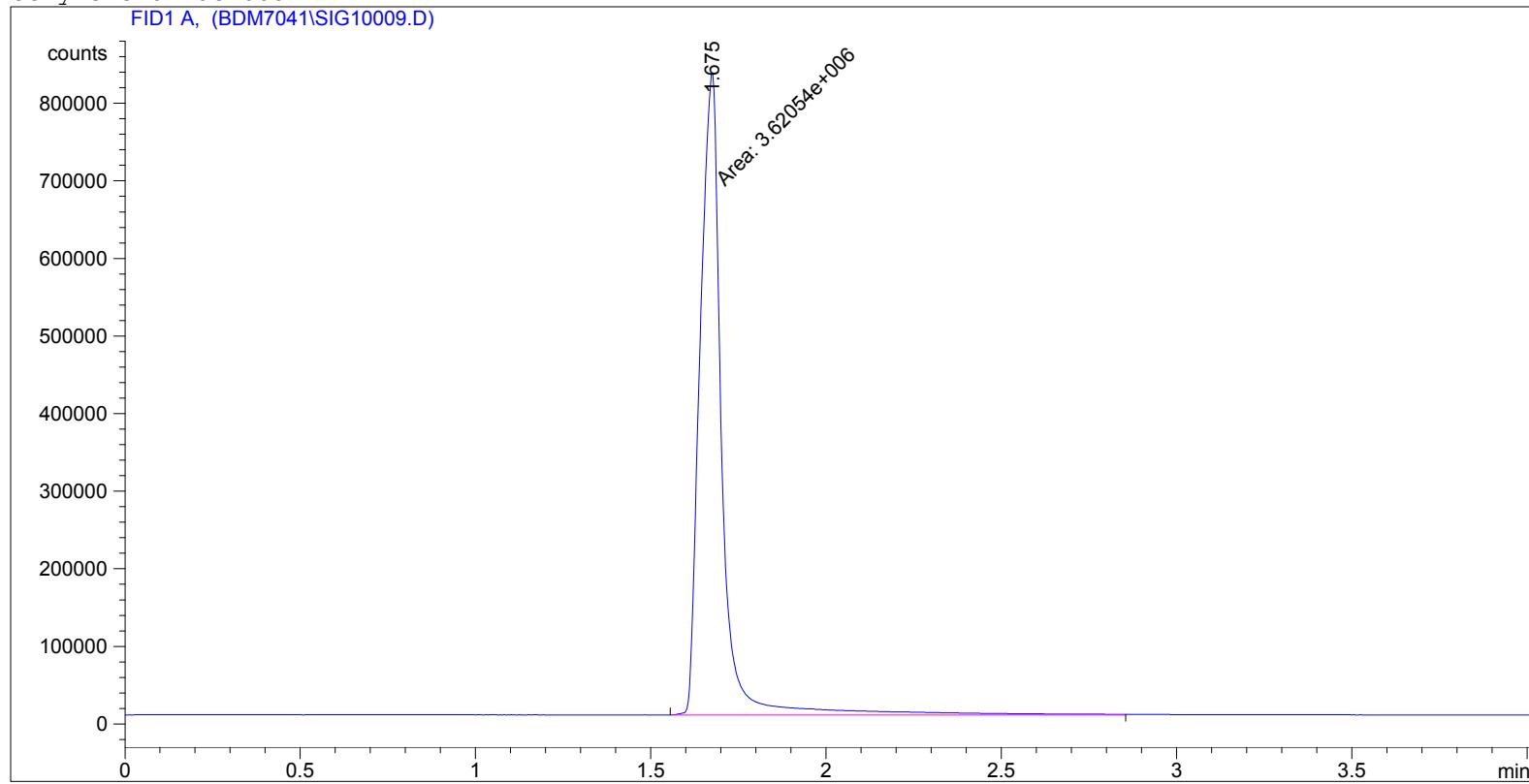
Totals : 3.63231e6 8.35353e5

Results obtained with enhanced integrator!

=====
*** End of Report ***
=====

Inlet Mid Level Cal 2611 EO ppm Inj 3

```
=====
Injection Date : 8/1/2017 1:56:26 PM
Sample Name : Pre 2611 Inj 3
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.675	MM	0.0728	3.62054e6	8.29332e5	1.000e2

Totals : 3.62054e6 8.29332e5

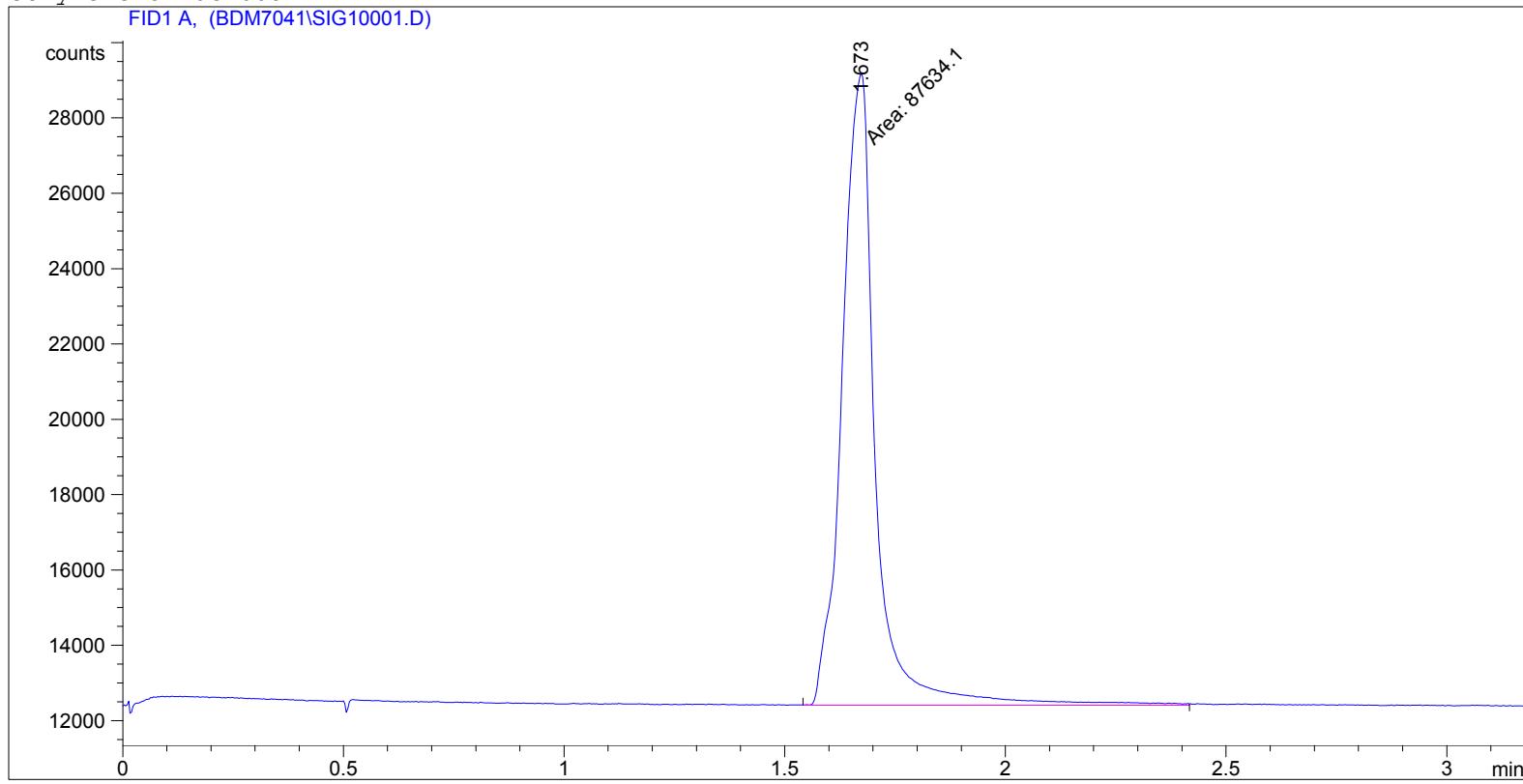
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Low Level Cal 50 ppm Inj 1 50 ppm EO

```
=====
Injection Date : 8/1/2017 12:16:56 PM
Sample Name : Pre 50 ppm Inj 1
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.673	MM	0.0870	8.76341e4	1.67915e4	1.000e2

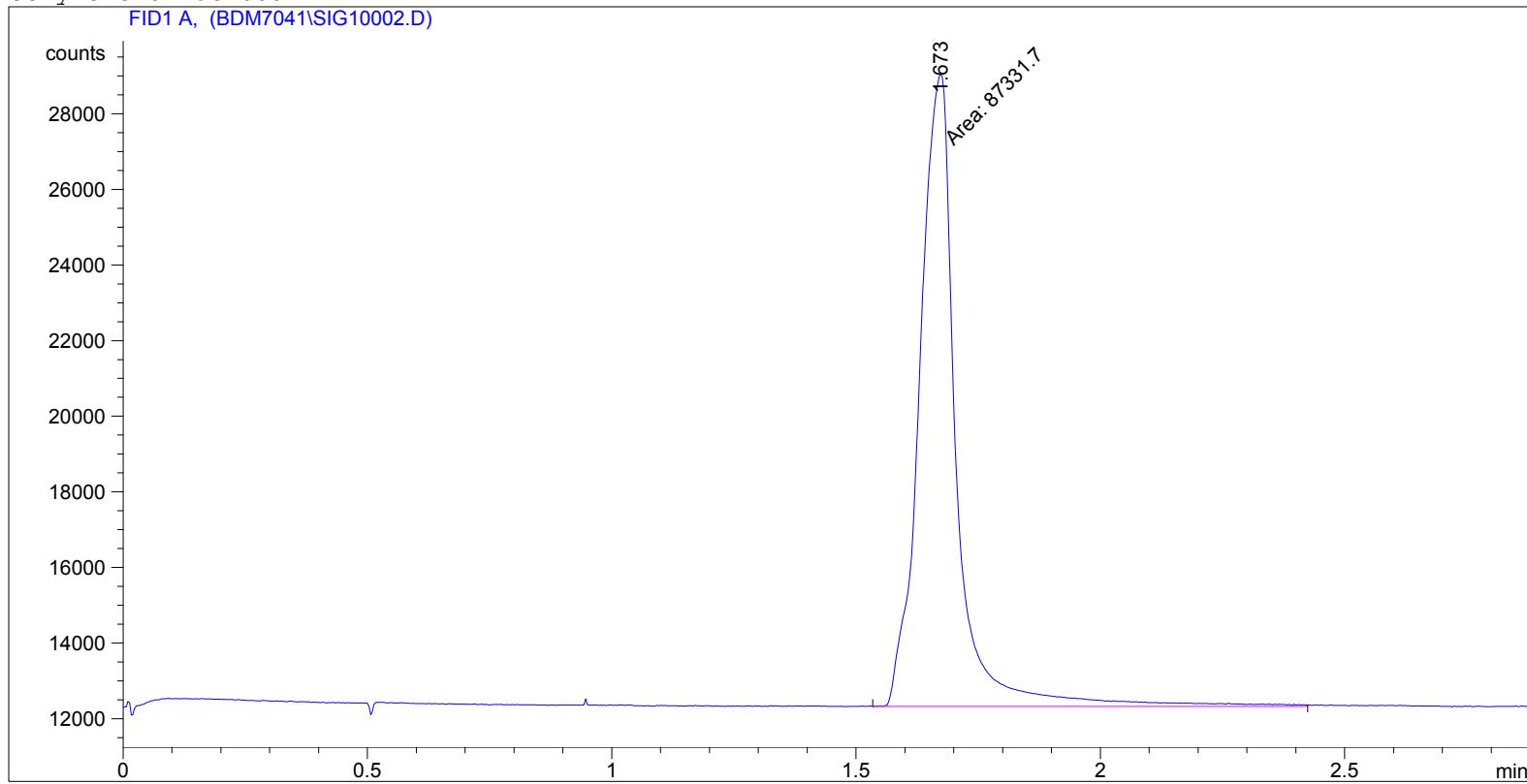
Totals : 8.76341e4 1.67915e4

Results obtained with enhanced integrator!

=====
*** End of Report ***

Inlet Low Level Cal 50 ppm Inj 2 50 ppm EO

```
=====
Injection Date : 8/1/2017 12:30:13 PM
Sample Name : Pre 50 ppm Inj 2
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.673	MM	0.0868	8.73317e4	1.67601e4	1.000e2

Totals : 8.73317e4 1.67601e4

Results obtained with enhanced integrator!

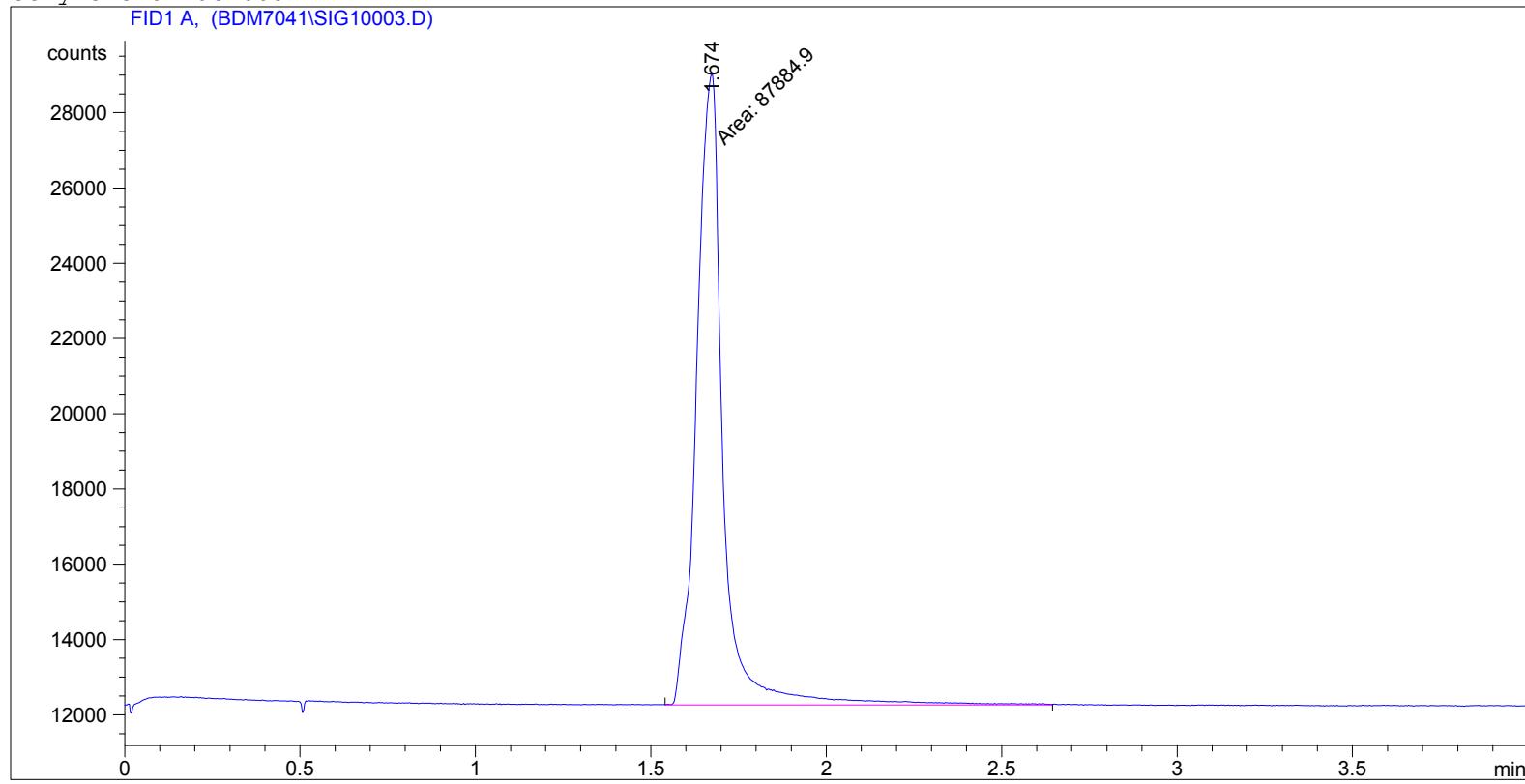
=====

*** End of Report ***

Inlet Low Level Cal 50 ppm Inj 3 50 ppm EO

=====

Injection Date : 8/1/2017 12:41:05 PM
Sample Name : Pre 50 ppm Inj 3 Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====

Area Percent Report

=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.674	MM	0.0872	8.78849e4	1.68003e4	1.000e2

Totals : 8.78849e4 1.68003e4

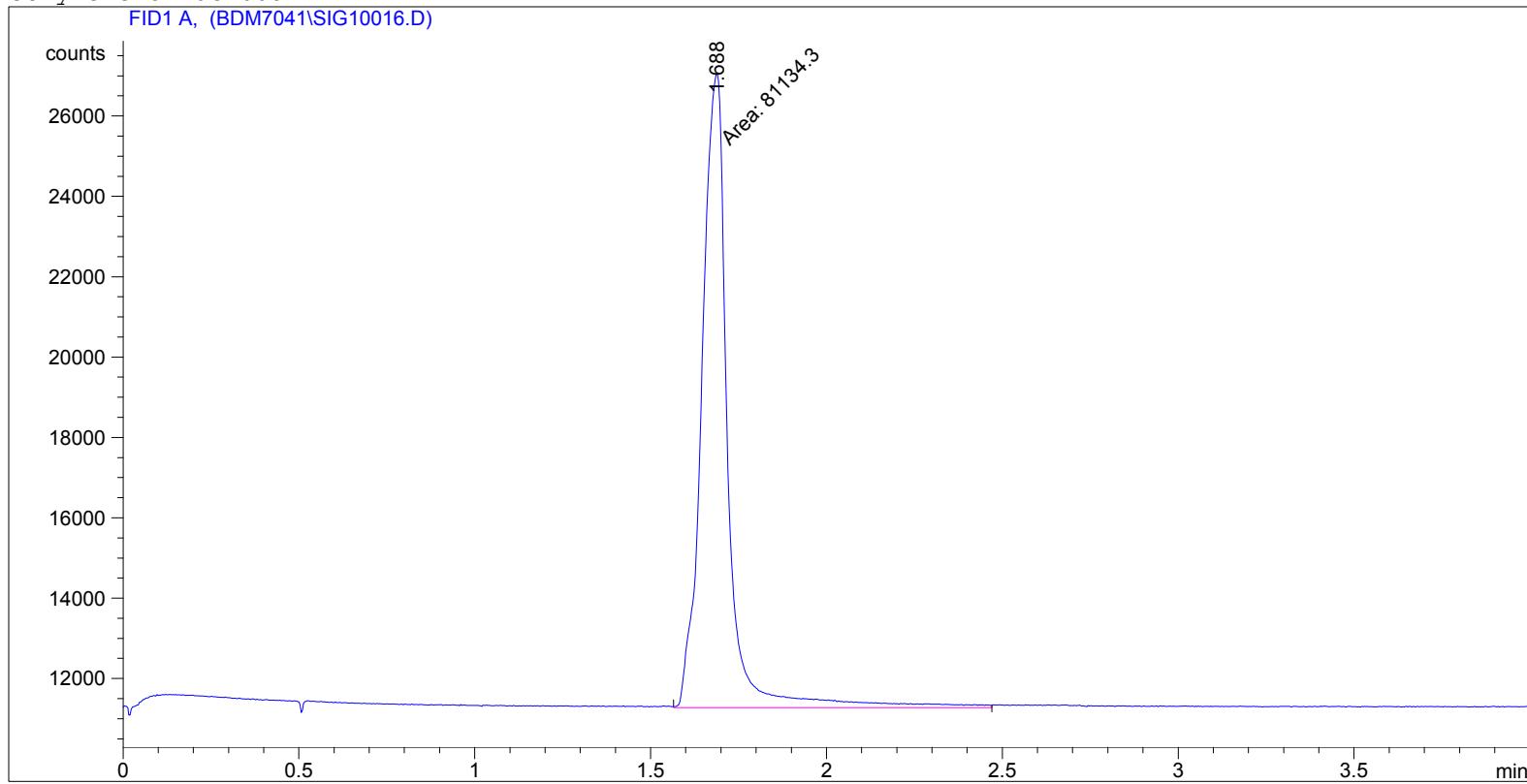
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Lineloss 50 ppm EO Inj 1

```
=====
Injection Date : 8/1/2017 4:50:18 PM
Sample Name : Inlet LL Inj 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.688	MM	0.0855	8.11342e4	1.58233e4	1.000e2

Totals : 8.11343e4 1.58233e4

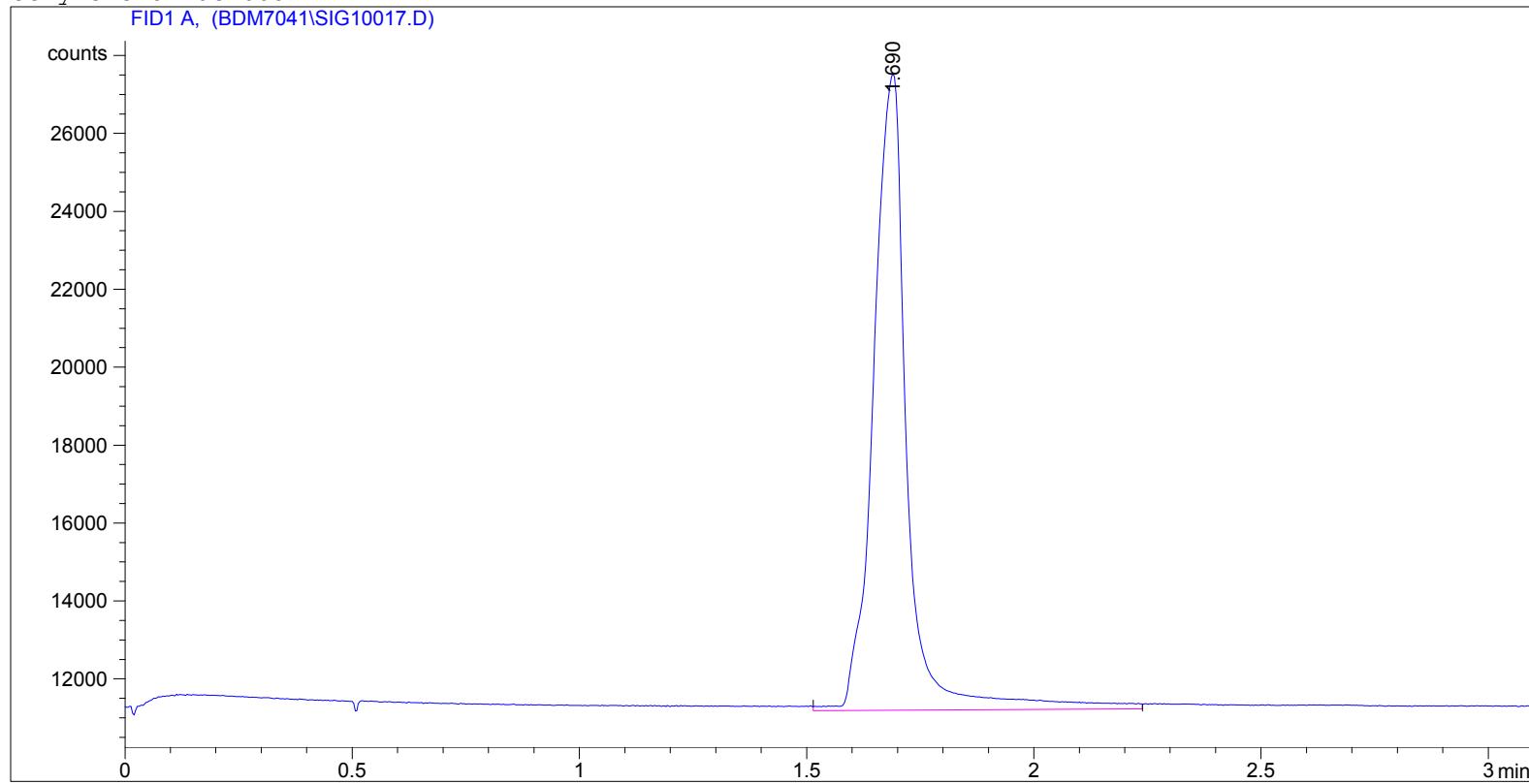
Results obtained with enhanced integrator!

=====

*** End of Report ***

Inlet Lineloss 50 ppm EO Inj 2

```
=====
Injection Date : 8/1/2017 5:01:00 PM
Sample Name : Inlet LL Inj 2
Location : Vial 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID1 A,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.690	VV	0.0792	8.43674e4	1.63546e4	1.000e2

Totals : 8.43674e4 1.63546e4

Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet

Outlet

Air Pollution Testing Inc. : EPA Method 2 - Pitot Traverse Datasheet

Reviewers Signature :

Output

Air Pollution Testing, Inc. : EPA Method 4 - Moisture Determination Datasheet											
APT Job #:	BDM70211	Date:	8-2-17	CO ₂ (%):	CDA5	O ₂ (%):	CDK5				
Location:	E6 Plant PSD Muskegon	Operator:	TG	Ambient Temperature (°F):	~80	Barometric Press (mbar):	26.7				
Run #:	1	Meter Box ID:	M5-111	Probe Length (ft):	~21	Moisture (grams):	15.4				
Meter Box Y _d :	1.000	Meter ΔH@:	1.69	Static Pressure (" H ₂ O):	-0.36	Start Time:	11:00				
Pre-Test Pump Leak Check: 0.0 e 15" Hg		Post-Test Pump Leak Check: 0.0 e 10" Hg	-	Method:	4	Stop Time:	12:00				
Sampling Time (minutes)	Vacuum (" Hg)	ΔH Orifice Setting (" H ₂ O)	T _m Meter Temp.	Condenser Temp. (°F)	Probe Temp. (°F)	Meter Volume (ft ³)	Initial Volume:	Notes			
5	2	1.0	78	63	T ₃	631.000	631.2				
10	2	1.0	80	78	51	631.5	631.5				
15	2	1.0	82	79	52	631.7	631.7				
20	2	1.0	83	79	52	631.9	631.9				
25	2	1.0	83	80	51	631.7	631.7				
30	2	1.0	84	80	51	632.1	632.1				
35	2	1.0	85	81	51	632.6	632.6				
40	2	1.0	86	81	52	632.9	632.9				
45	2	1.0	87	82	52	632.2	632.2				
50	2	1.0	88	83	53	633.5	633.5				
55	2	1.0	89	83	54	636.7	636.7				
60	2	1.0	89	84	55	639.475	639.475				
Stack ID (inches):											
Upstream Disturbance (inches):											
Downstream Disturbance (inches):											
200 gram Field Check of Scale (value):											
Moisture Determination											
Imp. #		Tare		Final		Gain					
1		4521.5		4522.5							
2		450.4		457.4							
3		241.2		302.4							
4		5141.3		5211.5							
Total		718.4		733.8							
Technician's Signature:											
Project Leader's Signature:											
Technician's Signature:											
Project Leader's Signature:											
maximum		average		maximum							
60		2		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							
75		1.0		1.0							
82.1		82.1		82.1							

Outlet

Air Pollution Testing, Inc. : EPA Method 4 - Moisture Determination Datasheet

APT Job #: BDN 70111

Location: BD Industrial E&O Plant

Run #: 2

Operator: T6

Meter Box ID: 115-14

Meter Box Yd: 169

Pre-Test Pump Leak Check: 0.0015" Hg

Post-Test Pump Leak Check: 0.0 e 10" Hg

Date: 8-2-17

CO₂ (%): 6.05

Ambient Temperature (°F): ~90

Barometric Press (mbar): 29.7

Probe Length (ft): ~41

Moisture (grams): 16.4

Static Pressure ("H₂O): -6.26

Start Time: 12:10

Method: 4

Stop Time: 13:10

Sampling Time (minutes)	Vacuum ("Hg)	ΔH Orifice Setting ("H ₂ O)	T _m Meter Temp. (°F)	Inlet Outlet (°F)	Condenser Temp. (°F)	Probe Temp. (°F)	Meter Volume (ft ³)	Initial Volume:	Notes	Schematic of Stack :
5	2	1.0	87	85	82	T5	670.240	673.41		
10	2	1.0	86	84	81		676.7			
15	2	1.0	90	86	84		674.9			
20	2	1.0	91	87	85		673.2			
25	2	1.0	92	87	85		676.5			
30	2	1.0	92	88	86		689.8			
35	2	1.0	93	88	86		693.0			
40	2	1.0	93	89	87		696.3			
45	2	1.0	94	89	87		699.5			
50	2	1.0	94	89	87		702.7			
55	2	1.0	95	89	87		706.0			
60	2	1.0	95	90	88		709.240			
Stack ID (inches):										
Upstream Disturbance (inches):										
Downstream Disturbance (inches):										
200 gram Field Check of Scale (value):										
Moisture Determination										
Imp. #										
1	452.5	423.1								
2	457.4	492.2								
3	301.2	305.0								
4	521.5	528.7								
Total	1732.6	1749.0								
Technician's Signature:										
Project Leader's Signature:										

89.5

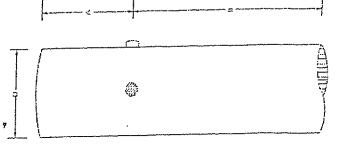
T5

89.5

1.0

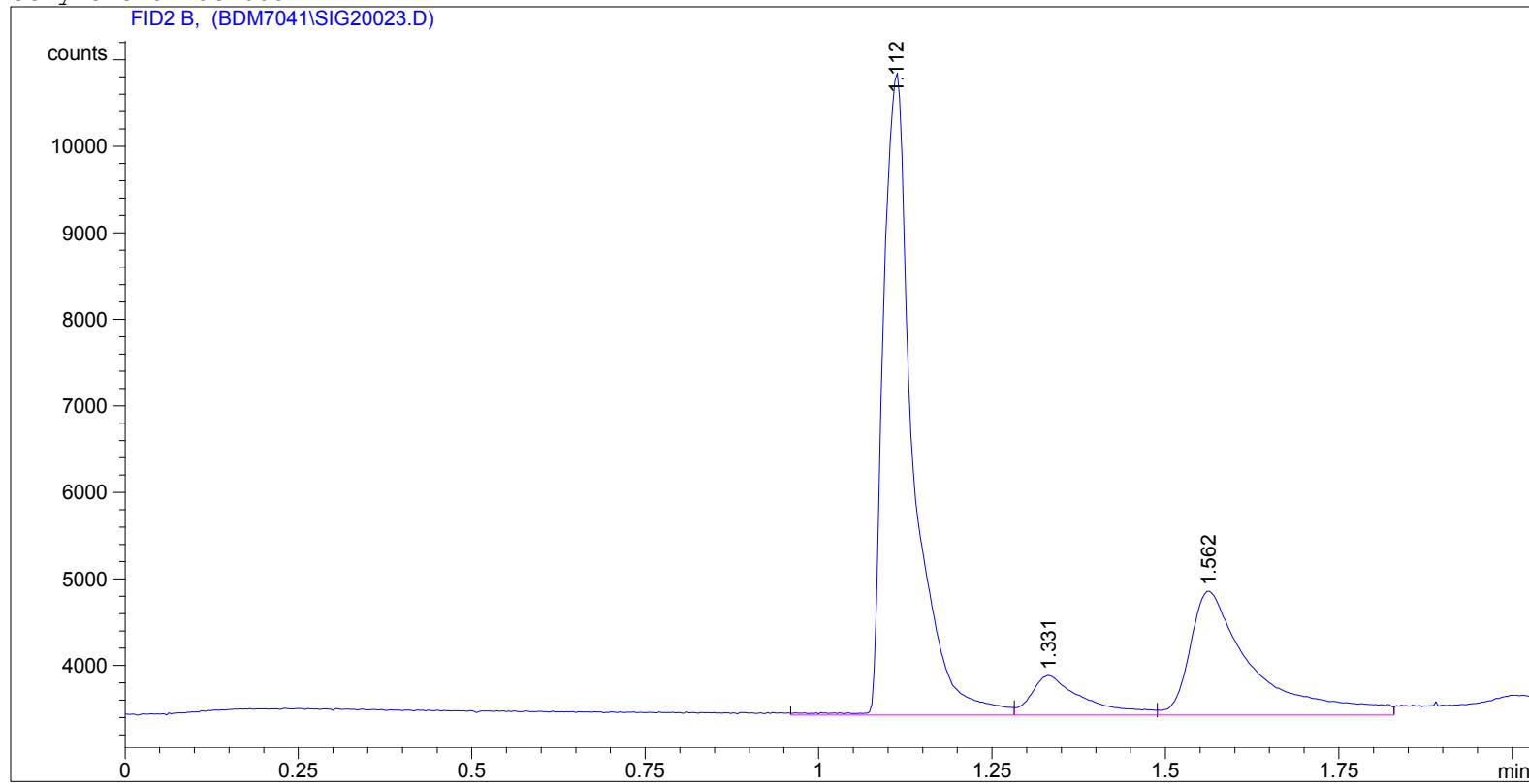
CO₂ (%): 6.05O₂ (%): CO AS

Outlet

Air Pollution Testing, Inc. : EPA Method 4 - Moisture Determination Datasheet									
APT Job #:	BDM7011	Date:	8-2-17	CO ₂ (%):	CDAS	O ₂ (%):	CDAS		
Location:	BD Mack 160 Plant	Operator:	TG	Ambient Temperature (°F):	89.5	Barometric Press (inbar):	26.7		
Run #	3	Meter Box ID:	M5-14	Probe Length (ft):	4.1	Moisture (grams):	14.1		
Meter Box Y _d :	1.000	Meter ΔH@:	1.69	Static Pressure (° H ₂ O):	-0.20	Start Time:	13:15		
Pre-Test Pump Leak Check: 0.0e15" Hg				Post-Test Pump Leak Check:	0.0e0 10 ⁻⁴ Hg	Method:	4	Stop Time:	14:15
Sampling Time (minutes)	Vacuum (" Hg)	ΔH Orifice Setting (" H ₂ O)	T _m Meter Temp. (°F)	Inlet Outlet (°F)	Condenser Temp. (°F)	Probe Temp. (°F)	Meter Volume (ft ³)	Initial Volume:	Notes
5	2	1.0	92	90	216	15	712.8	701.527	
10	2	1.0	93	90	216	15	716.1	716.1	Schematic of Stack :
15	2	1.0	93	91	216	15	719.4	719.4	
20	2	1.0	94	91	217	17	723.6	723.6	
25	2	1.0	95	91	217	17	723.8	723.8	
30	2	1.0	95	92	218	18	728.1	728.1	
35	2	1.0	96	92	218	18	732.4	732.4	
40	2	1.0	96	93	219	19	735.0	735.0	
45	2	1.0	96	93	219	19	738.8	738.8	
50	2	1.0	97	93	219	20	740.0	740.0	
55	2	1.0	97	93	219	20	745.3	745.3	
60	2	1.0	97	93	219	20	748.581	748.581	
							Stack ID (inches):		
							Upstream Disturbance (inches):		
							Downstream Disturbance (inches):		
							200 gram Field Check of Scale (value):		
Moisture Determination									
							Imp. #	Tare	Final
							1	451.8	435.7
							2	448.2	467.4
							3	300.9	306.0
							4	528.7	534.6
total	maximum	average	maximum	average	difference		Total	1729.6	1743.7
60	2	1.0	93.5	93.5			Technician's Signature:		

Outlet Stack Gas Inj 1

```
=====
Injection Date : 8/2/2017 10:32:16 AM
Sample Name : Out Stack Gas
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.112	VV	0.0460	2.23456e4	7438.66260	66.35962
2	1.331	VV	0.0699	2358.87256	459.42453	7.00514
3	1.562	VV	0.0861	8969.01367	1430.97876	26.63525

Totals : 3.36735e4 9329.06589

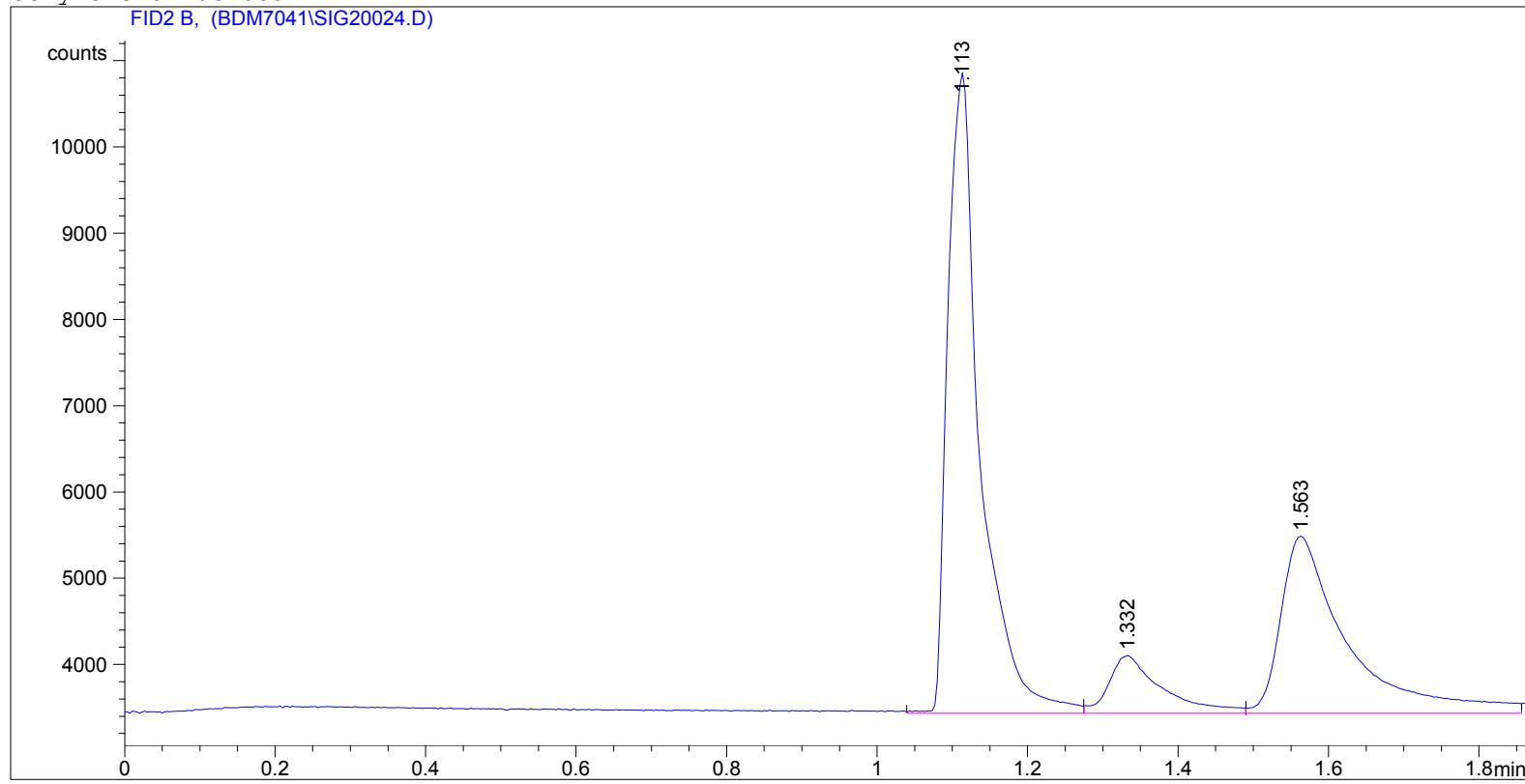
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Stack Gas Inj 2

```
=====
Injection Date : 8/2/2017 10:37:42 AM
Sample Name : Out Stack Gas
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.113	VV	0.0460	2.22606e4	7428.27100	58.32173
2	1.332	VV	0.0679	3265.89453	669.79364	8.55648
3	1.563	VV	0.0849	1.26421e4	2052.00562	33.12179

Totals : 3.81687e4 1.01501e4

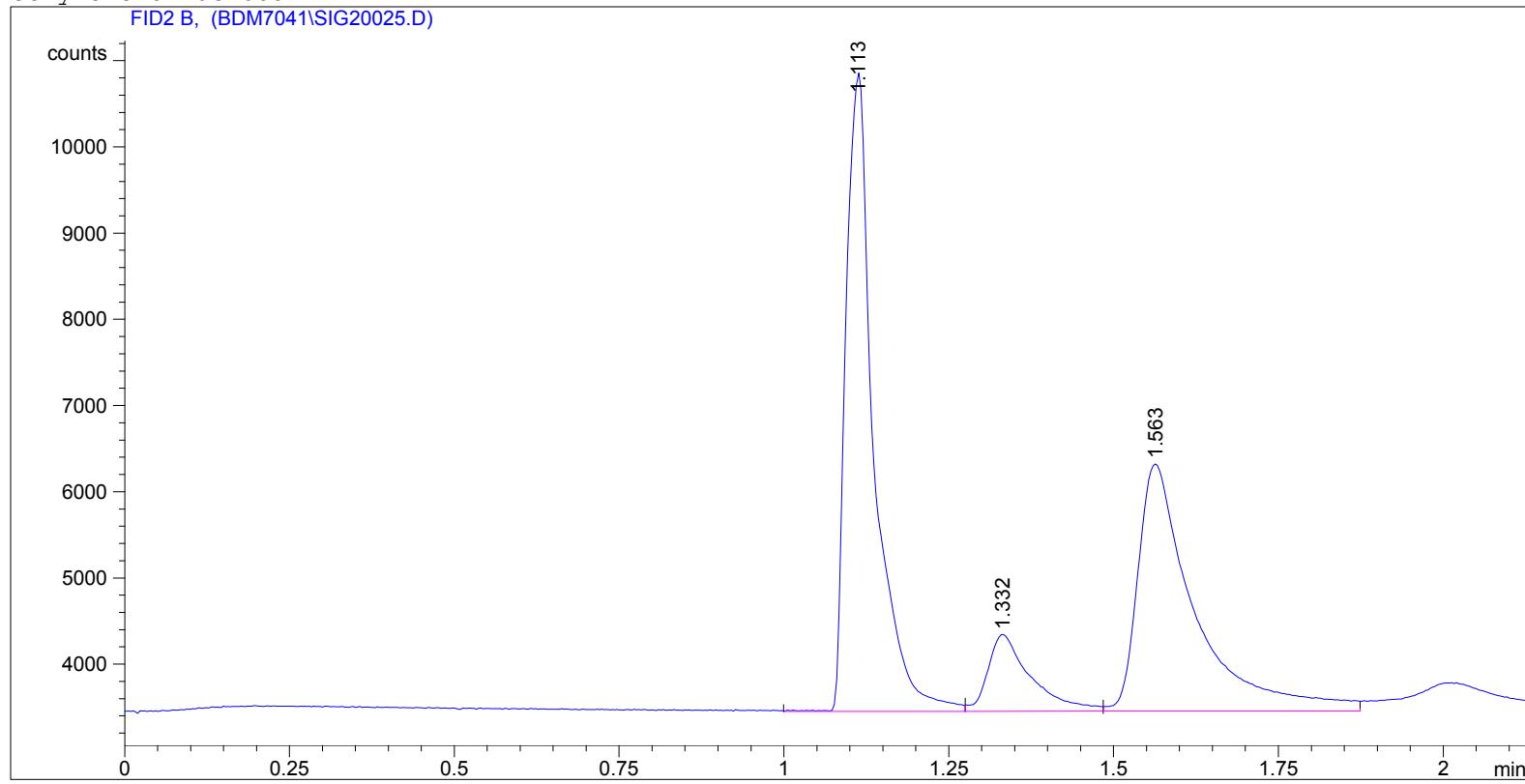
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Stack Gas Inj 3

```
=====
Injection Date : 8/2/2017 10:43:10 AM
Sample Name : Out Stack Gas
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.113	VV	0.0455	2.19158e4	7409.09668	50.81758
2	1.332	VV	0.0636	4007.34814	889.15704	9.29210
3	1.563	VV	0.0830	1.72033e4	2869.07739	39.89033

Totals : 4.31264e4 1.11673e4

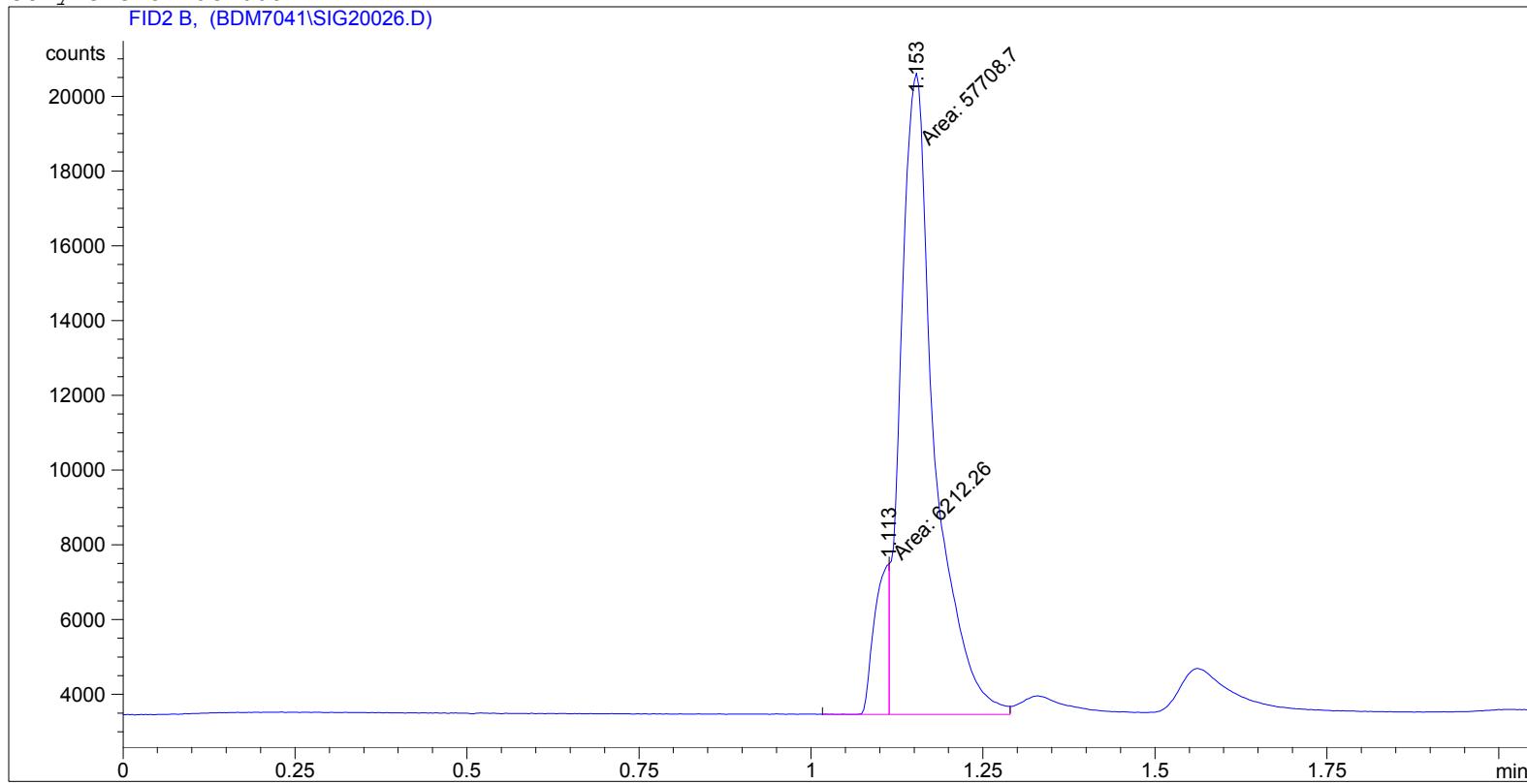
Results obtained with enhanced integrator!

=====

*** End of Report ***

Spiked Bag 50:50 Outlet Stack gas & 50 ppm EO Inj 1

```
=====
Injection Date : 8/2/2017 10:48:55 AM
Sample Name : Spiked Bag II
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.113	MF	0.0257	6212.26270	4022.09106	9.71867
2	1.153	FM	0.0560	5.77087e4	1.71818e4	90.28133

Totals : 6.39209e4 2.12039e4

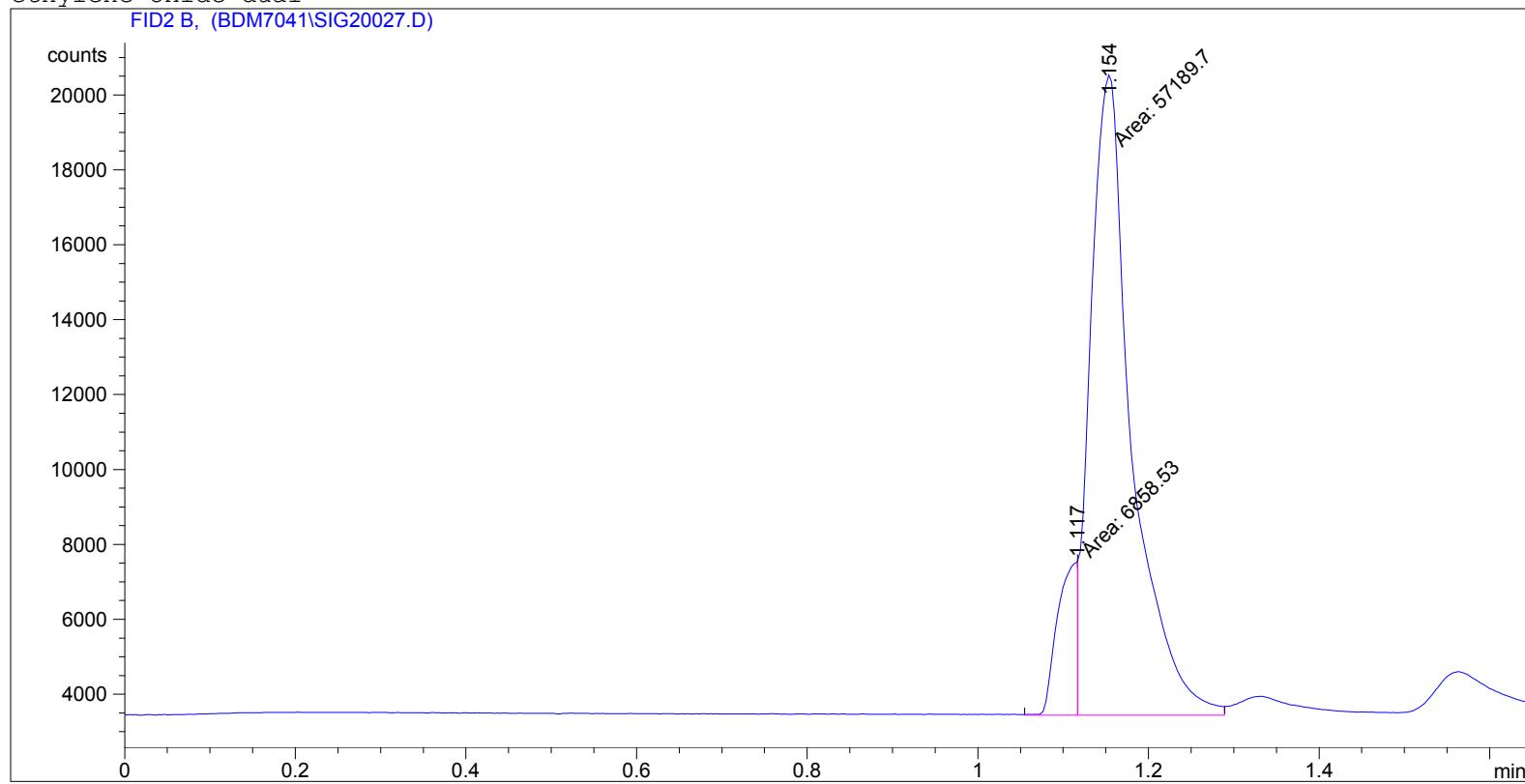
Results obtained with enhanced integrator!

=====

*** End of Report ***

Spiked Bag 50:50 Outlet Stack gas & 50 ppm EO Inj 2

```
=====
Injection Date : 8/2/2017 10:55:12 AM
Sample Name : Spiked Bag I2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.117	MF	0.0279	6858.53125	4091.62500	10.70838
2	1.154	FM	0.0557	5.71897e4	1.71183e4	89.29162

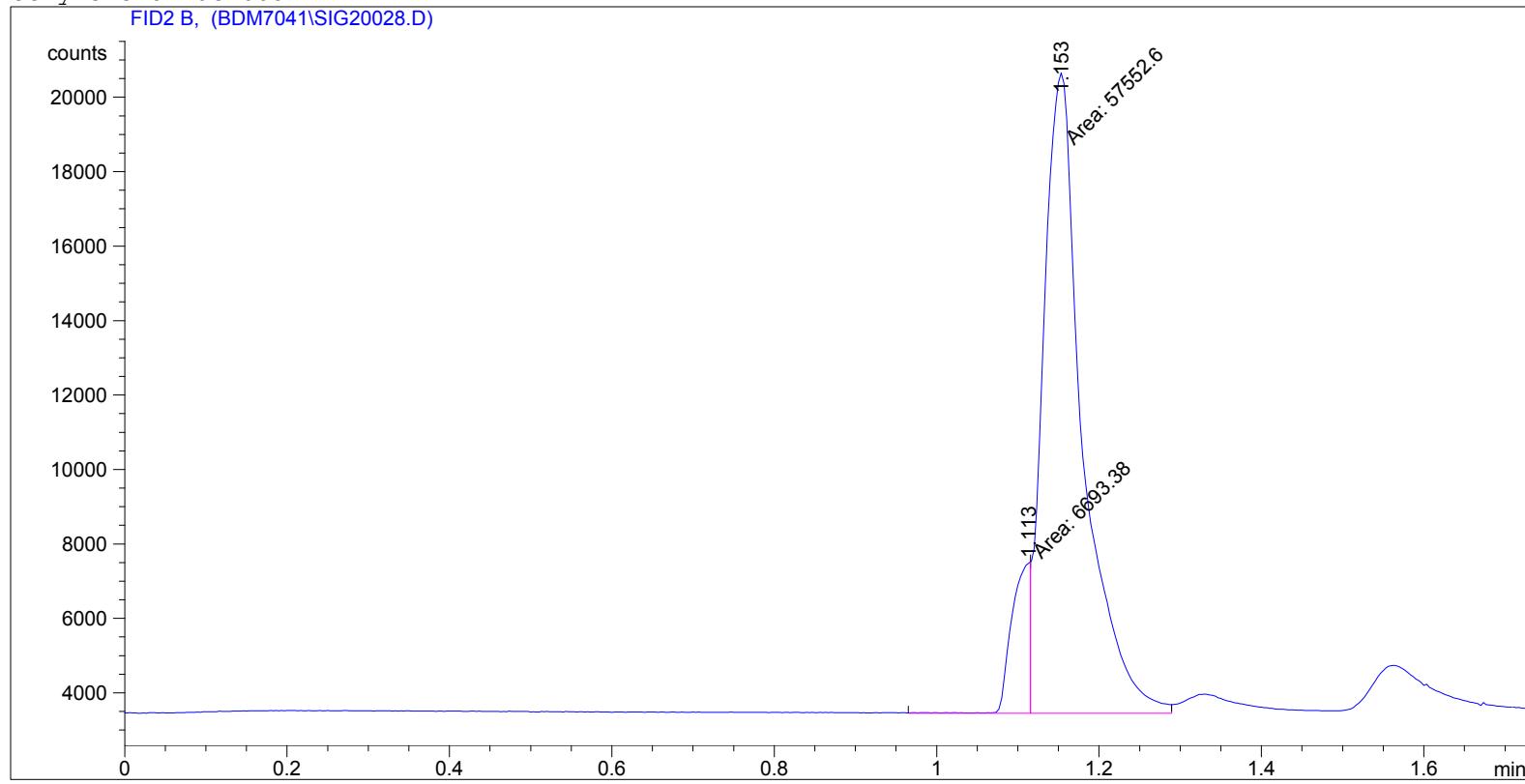
Totals : 6.40483e4 2.12099e4

Results obtained with enhanced integrator!

```
=====
*** End of Report ***
=====
```

Spiked Bag 50:50 Outlet Stack gas & 50 ppm EO Inj 3

```
=====
Injection Date : 8/2/2017 10:58:25 AM
Sample Name : Spiked Bag 3
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.113	MF	0.0277	6693.37793	4034.29663	10.41836
2	1.153	FM	0.0557	5.75526e4	1.72222e4	89.58164

Totals : 6.42460e4 2.12565e4

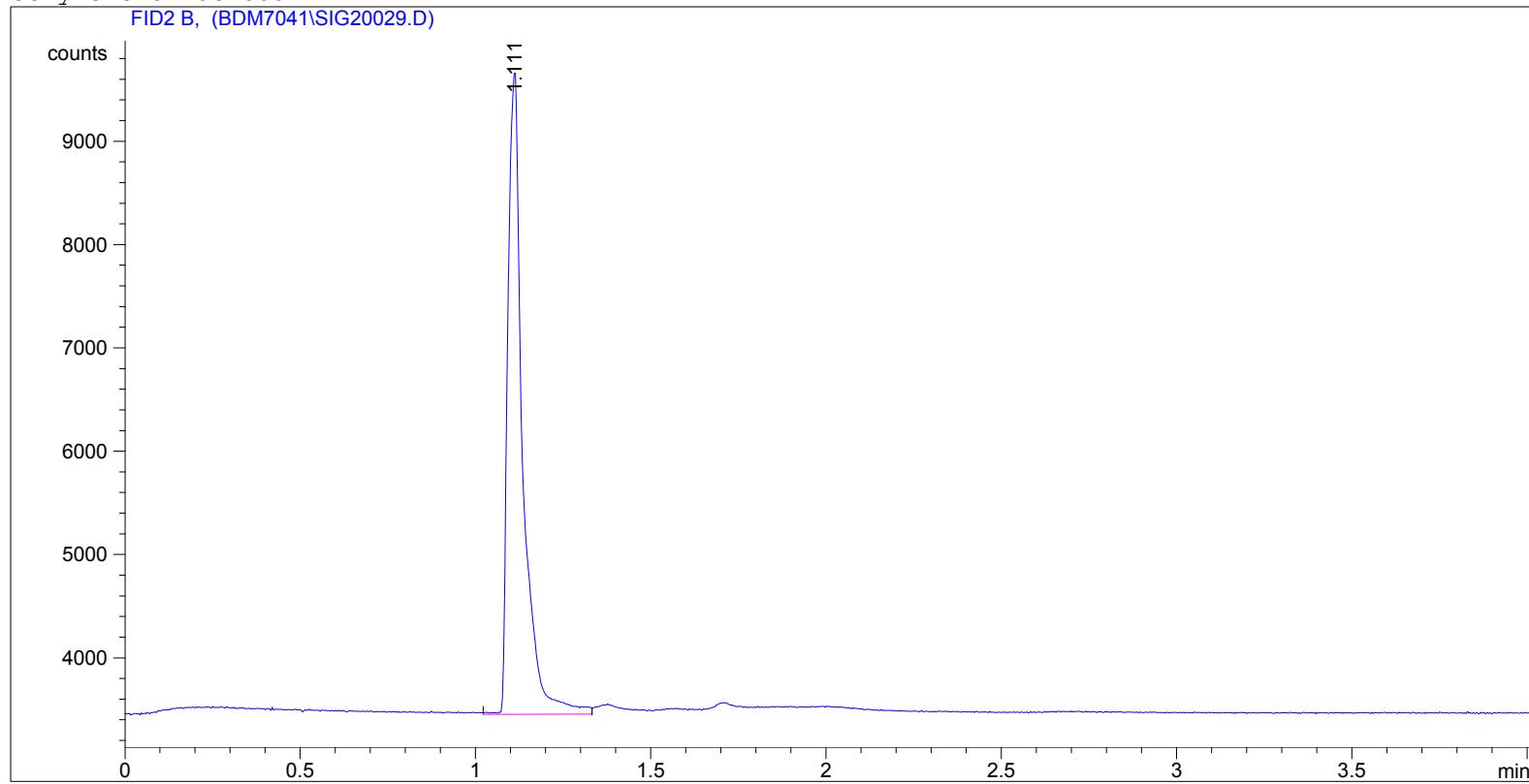
Results obtained with enhanced integrator!

=====
*** End of Report ***

Outlet Run 1 Inj 1

=====

Injection Date : 8/2/2017 11:05:04 AM
Sample Name : Run 1 Out II1 Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====

Area Percent Report

=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.111	VV	0.0446	1.84542e4	6213.74268	1.000e2

Totals : 1.84542e4 6213.74268

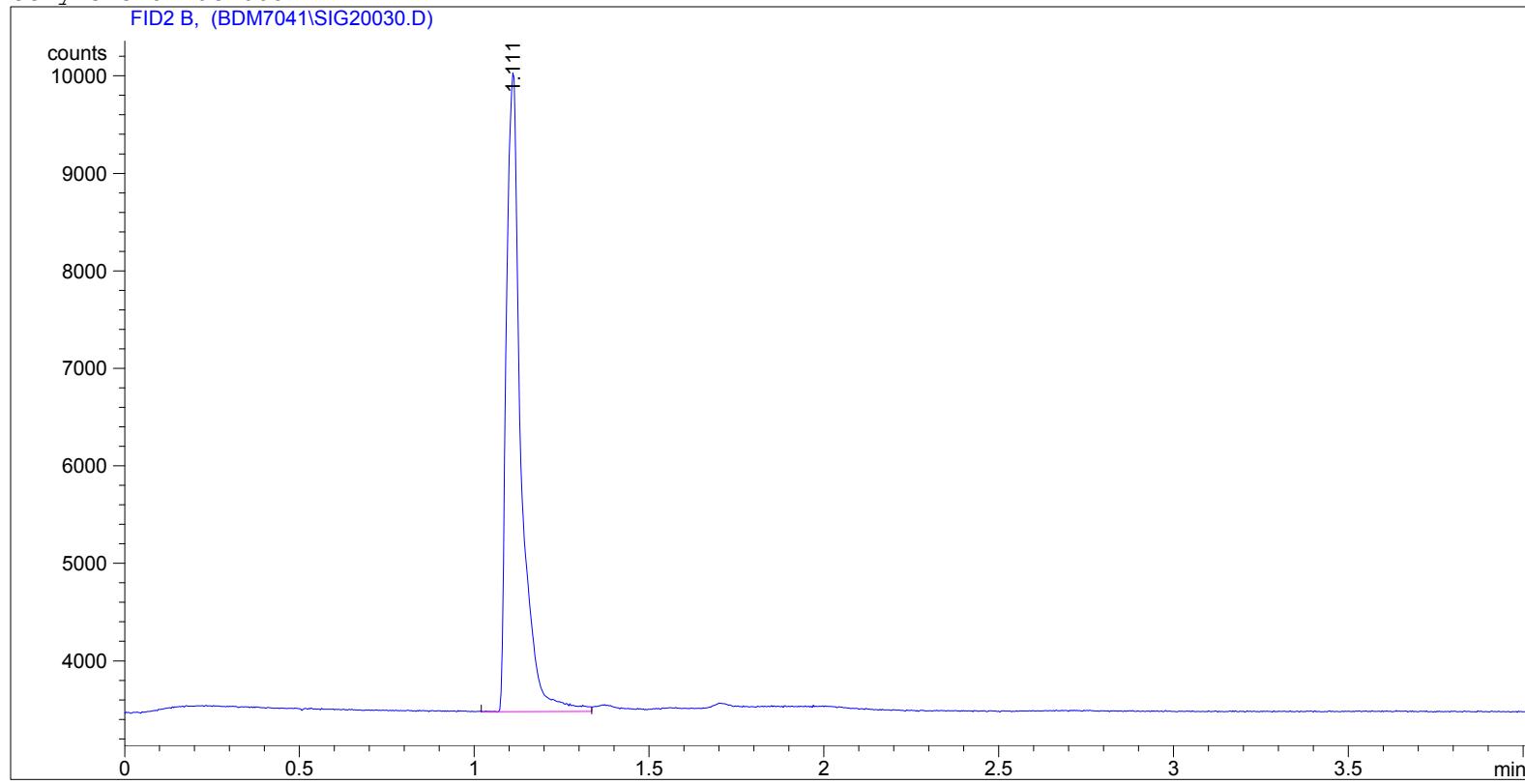
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Run 1 Inj 2

```
=====
Injection Date : 8/2/2017 11:14:49 AM
Sample Name : Run 1 Out I2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.111	VV	0.0450	1.90985e4	6554.55518	1.000e2

Totals : 1.90985e4 6554.55518

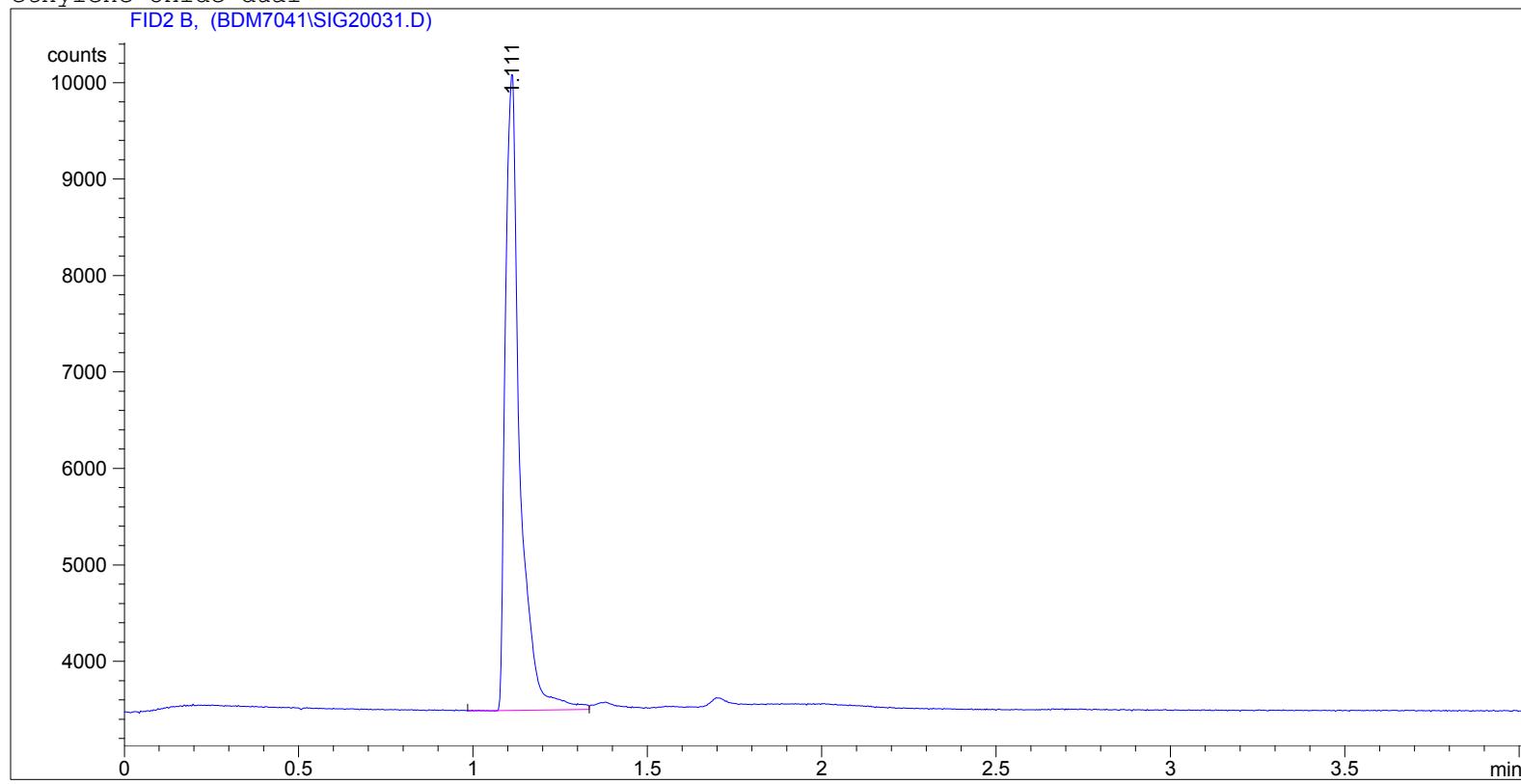
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Run 1 Inj 3

```
=====
Injection Date : 8/2/2017 11:25:44 AM
Sample Name : Run 1 Out I3
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.111	VV	0.0436	1.90175e4	6605.02393	1.000e2

Totals : 1.90175e4 6605.02393

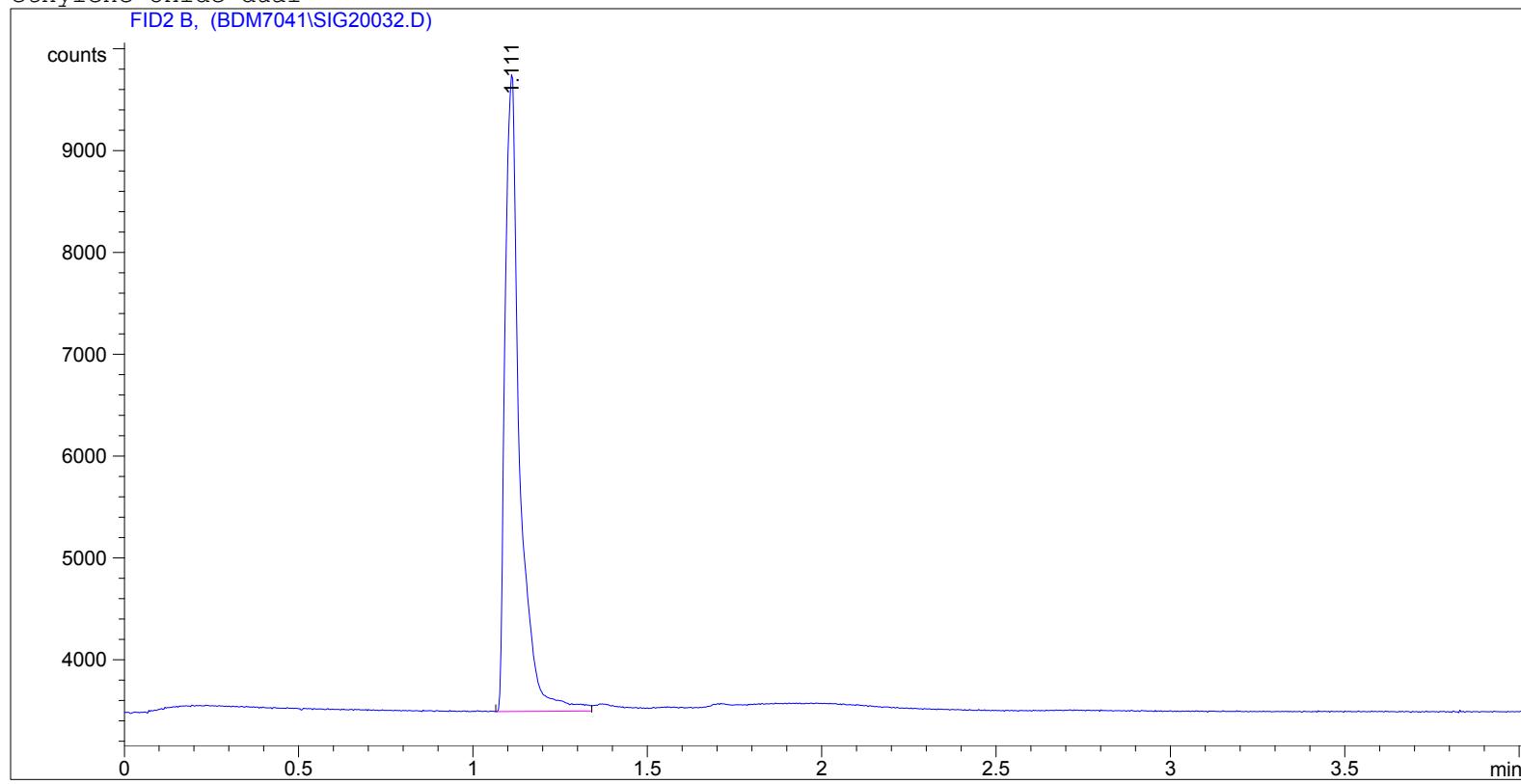
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Run 1 Inj 4

```
=====
Injection Date : 8/2/2017 11:44:12 AM
Sample Name : Run 1 Out I4
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.111	VV	0.0452	1.83153e4	6256.51416	1.000e2

Totals : 1.83153e4 6256.51416

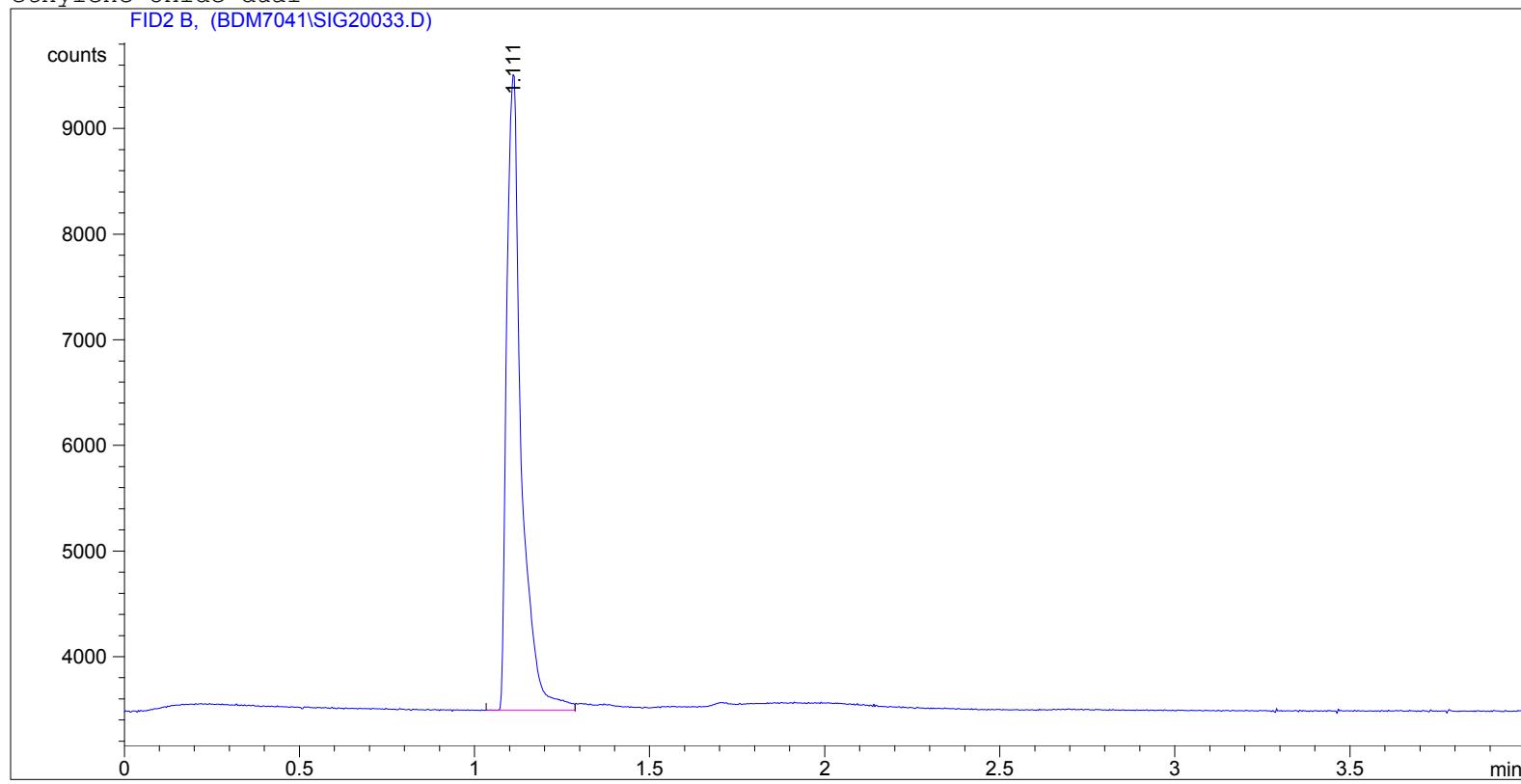
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Run 1 Inj 5

```
=====
Injection Date : 8/2/2017 11:56:45 AM
Sample Name : Run 1 Out I5
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.111	BV	0.0439	1.74728e4	6020.31592	1.000e2

Totals : 1.74728e4 6020.31592

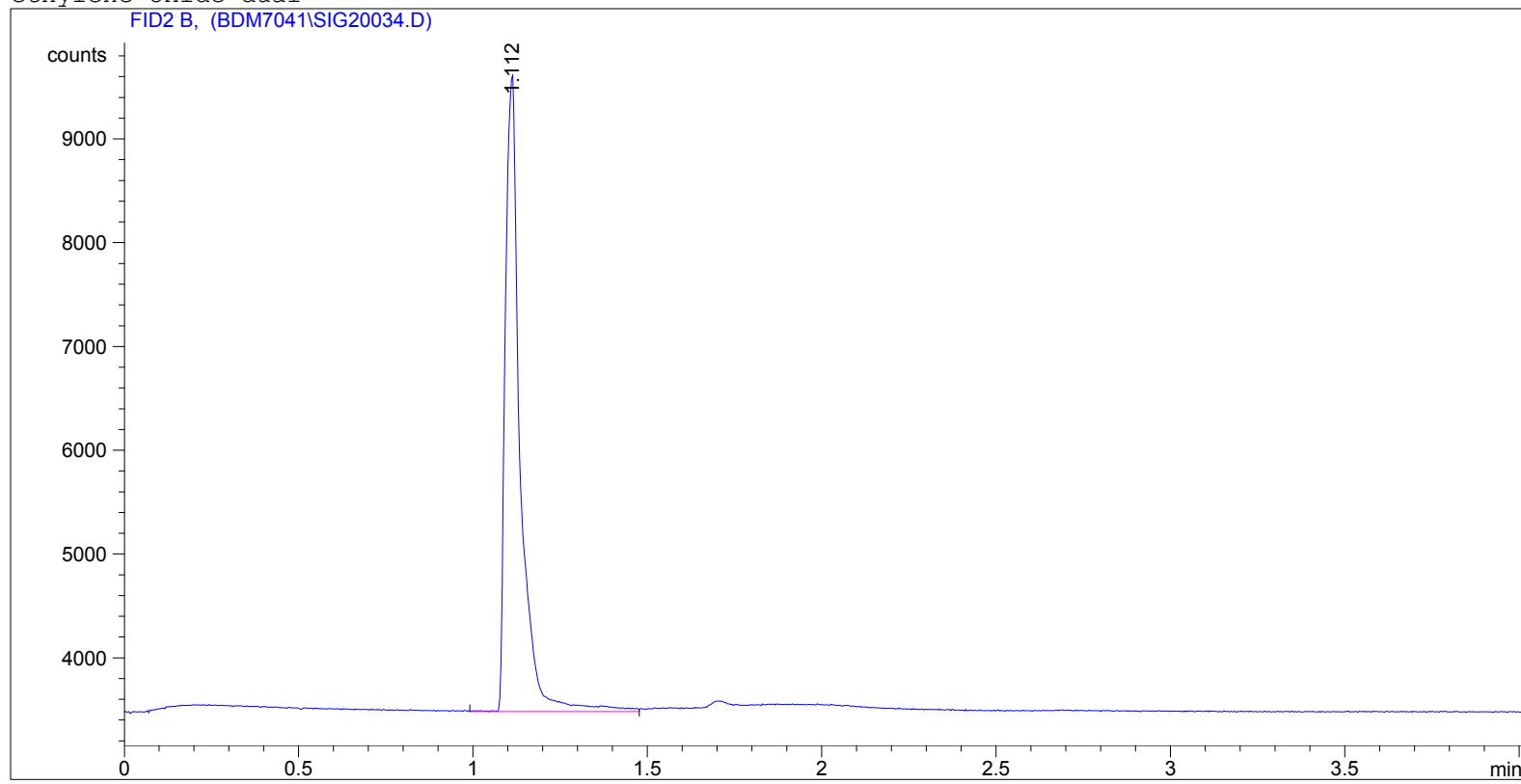
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Run 2 Inj 1

```
=====
Injection Date : 8/2/2017 12:15:28 PM
Sample Name : Run 2 Out II1
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.112	VV	0.0449	1.82865e4	6111.82813	1.000e2

Totals : 1.82865e4 6111.82813

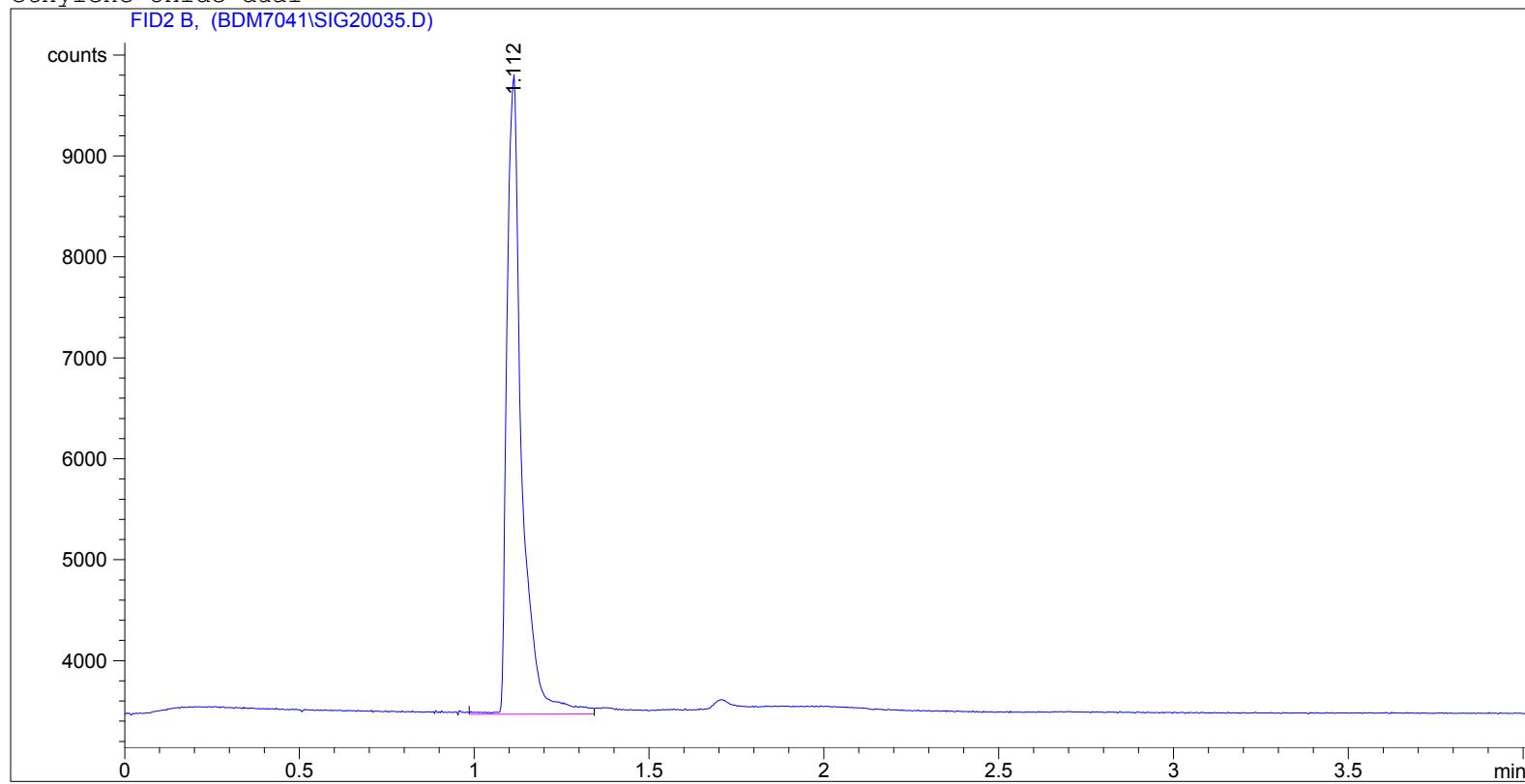
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Run 2 Inj 2

```
=====
Injection Date : 8/2/2017 12:23:29 PM
Sample Name : Run 2 Out I2
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.112	VV	0.0452	1.86179e4	6344.32227	1.000e2

Totals : 1.86179e4 6344.32227

Results obtained with enhanced integrator!

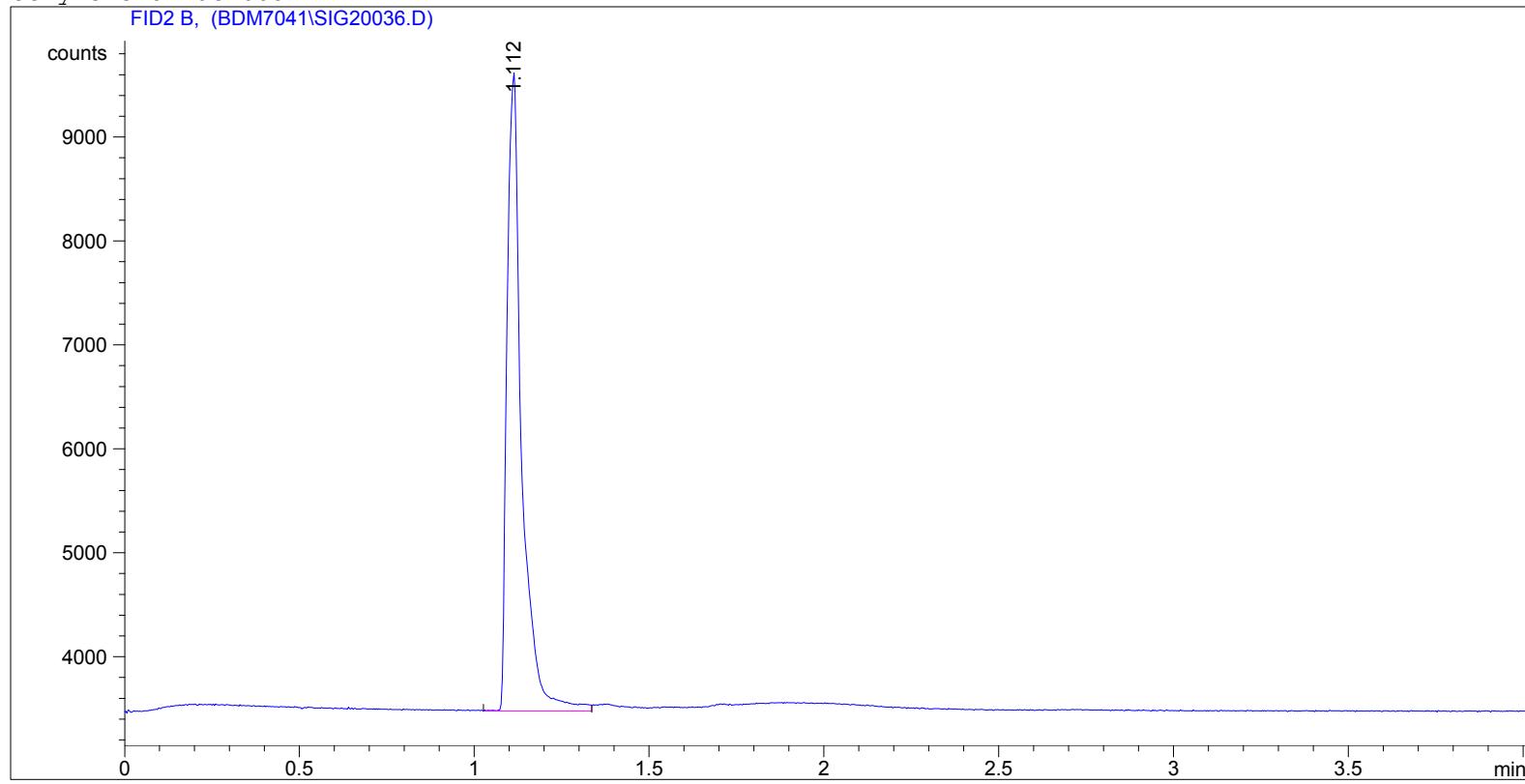
=====

*** End of Report ***

Outlet Run 2 Inj 3

=====

Injection Date : 8/2/2017 12:37:50 PM
Sample Name : Run 2 Out I3 Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====

Area Percent Report

=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.112	VV	0.0451	1.79685e4	6151.29102	1.000e2

Totals : 1.79685e4 6151.29102

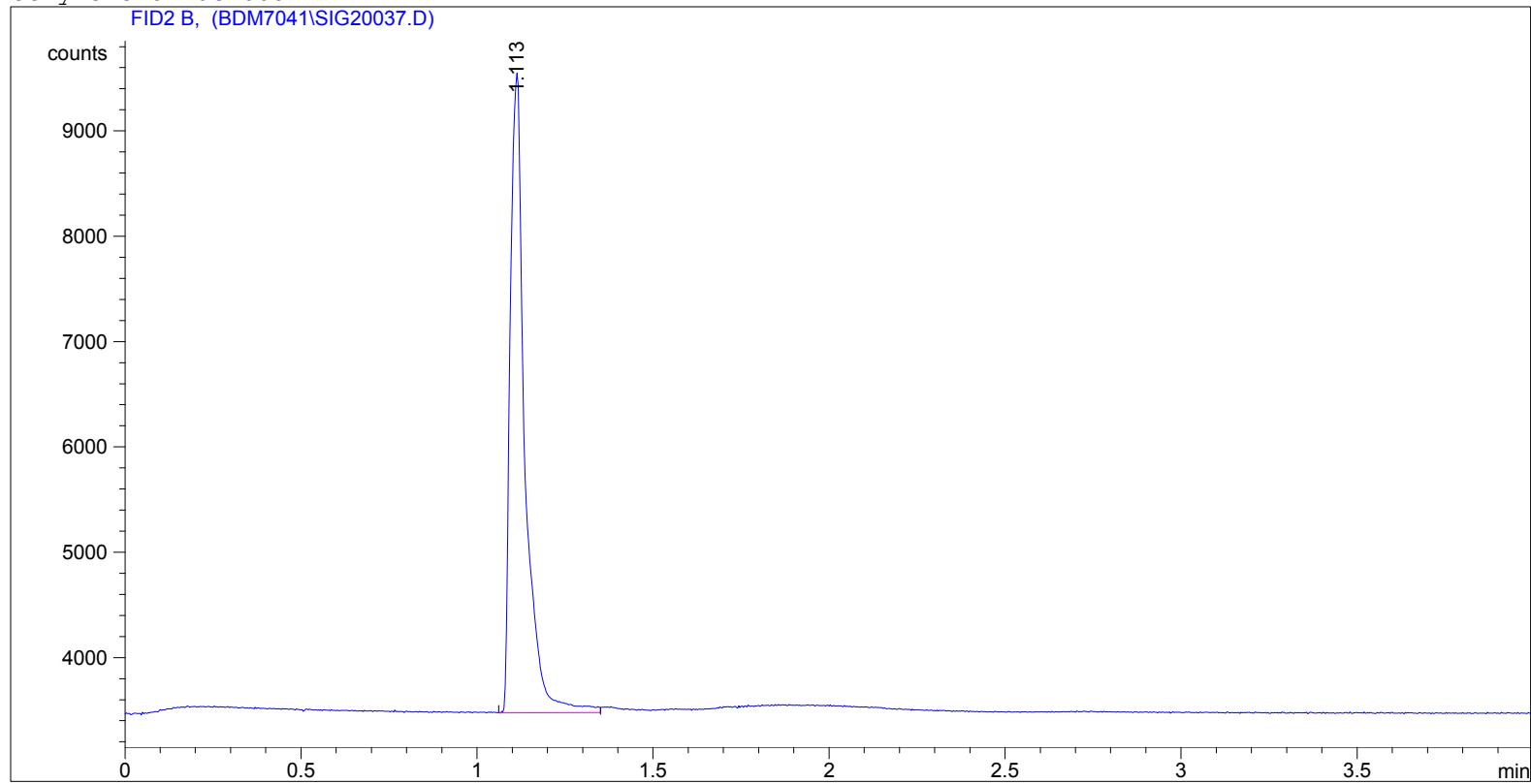
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Run 2 Inj 4

Injection Date : 8/2/2017 12:50:36 PM
Sample Name : Run 2 Out I4 Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



Area Percent Report

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.113	VV	0.0451	1.77359e4	6075.00195	1.000e2

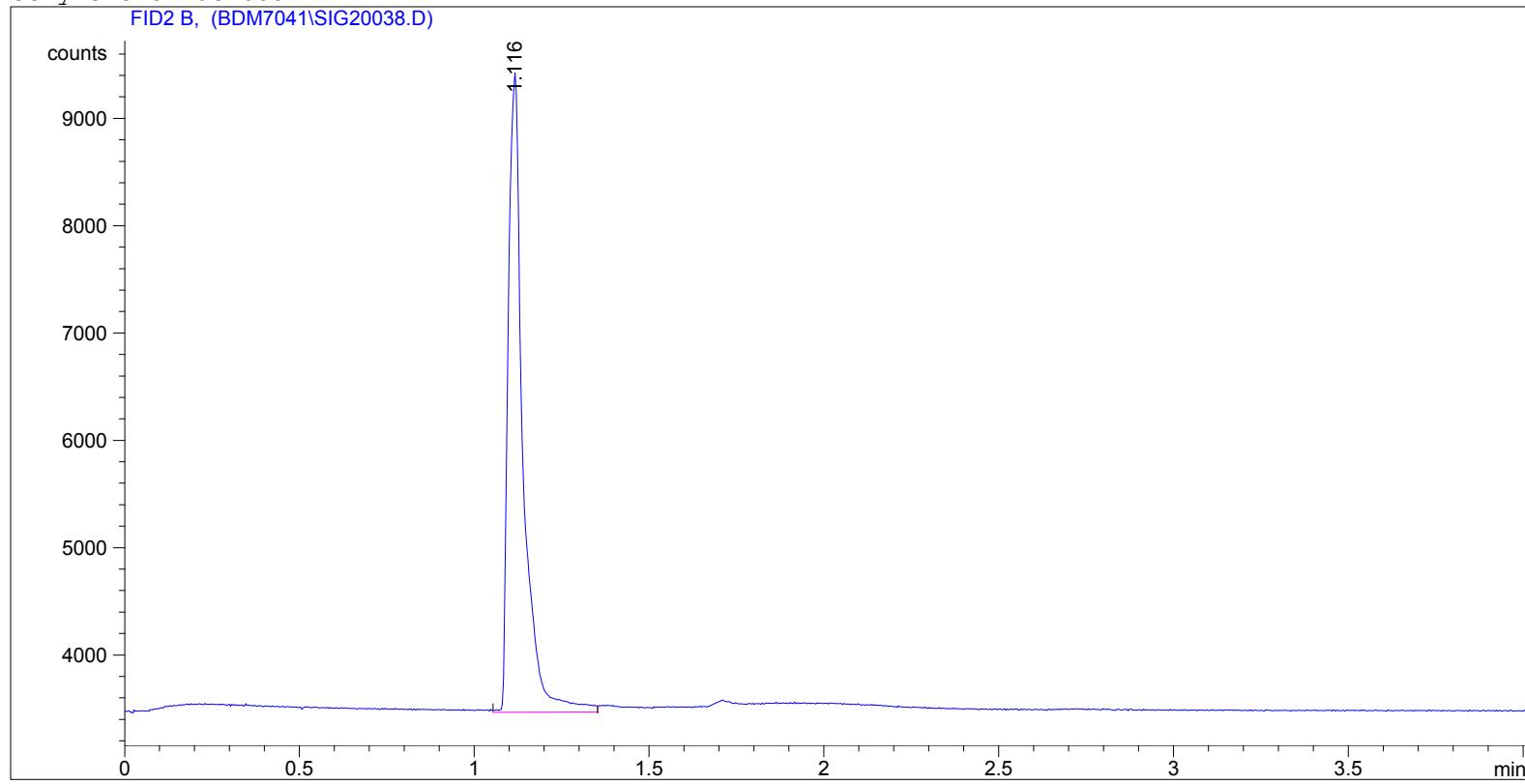
Totals : 1.77359e4 6075.00195

Results obtained with enhanced integrator

*** End of Report ***

Outlet Run 2 Inj 5

```
=====
Injection Date : 8/2/2017 1:05:15 PM
Sample Name : Run 2 Out I5
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.116	VV	0.0455	1.76577e4	5965.10791	1.000e2

Totals : 1.76577e4 5965.10791

Results obtained with enhanced integrator!

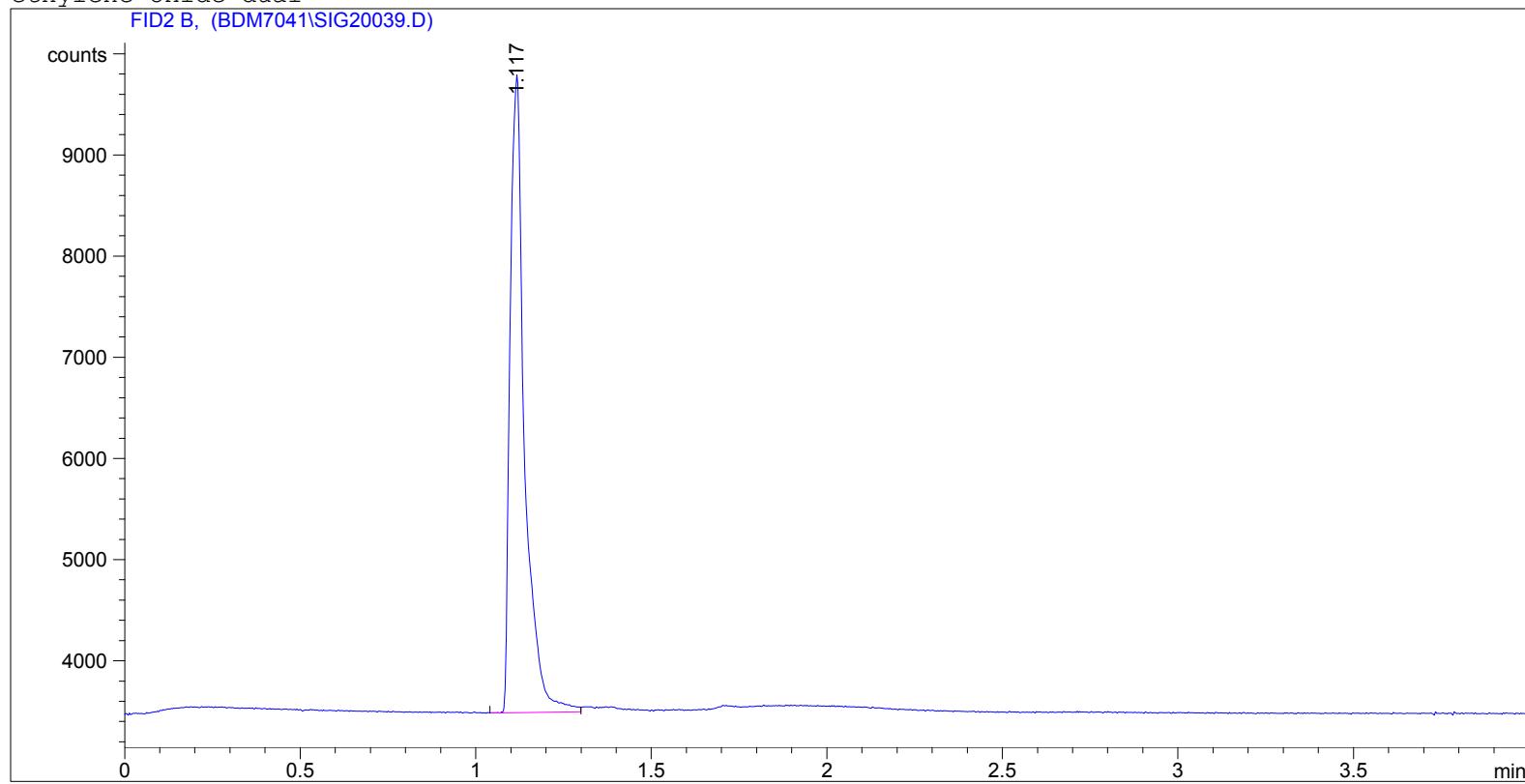
=====

*** End of Report ***

Outlet Run 3 Inj 1

=====

Injection Date : 8/2/2017 1:20:35 PM
Sample Name : Run 3 Out I1 Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====

Area Percent Report

=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.117	VV	0.0445	1.81194e4	6303.03271	1.000e2

Totals : 1.81194e4 6303.03271

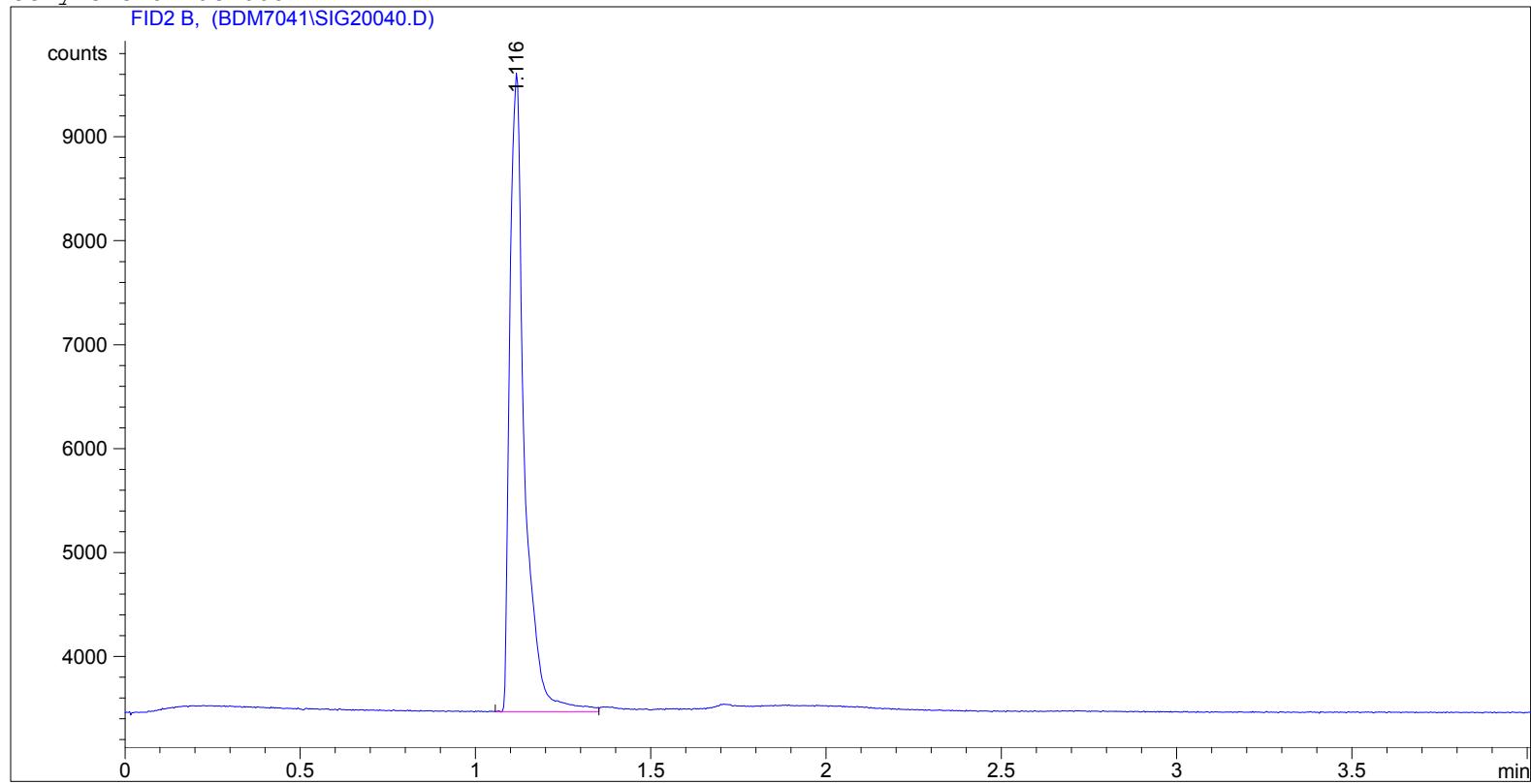
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Run 3 Inj 2

Injection Date : 8/2/2017 1:36:09 PM
Sample Name : Run 3 Out I2 Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



Area Percent Report

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.116	VV	0.0450	1.78822e4	6143.63867	1.000e2

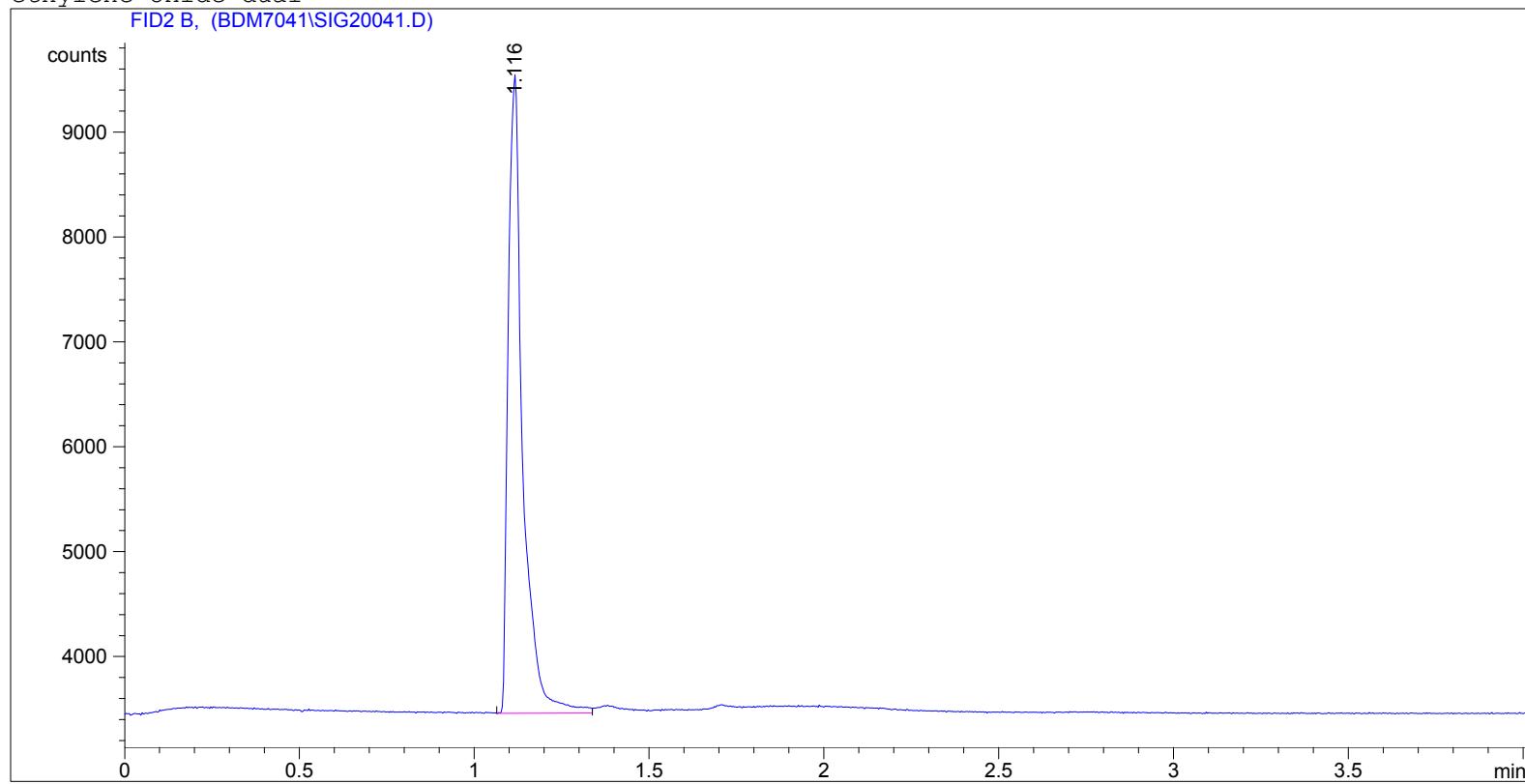
Totals : 1.78822e4 6143.63867

Results obtained with enhanced integrator

*** End of Report ***

Outlet Run 3 Inj 3

=====
Injection Date : 8/2/2017 1:44:29 PM
Sample Name : Run 3 Out I3 Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====
Area Percent Report
=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.116	VV	0.0446	1.75911e4	6099.64600	1.000e2

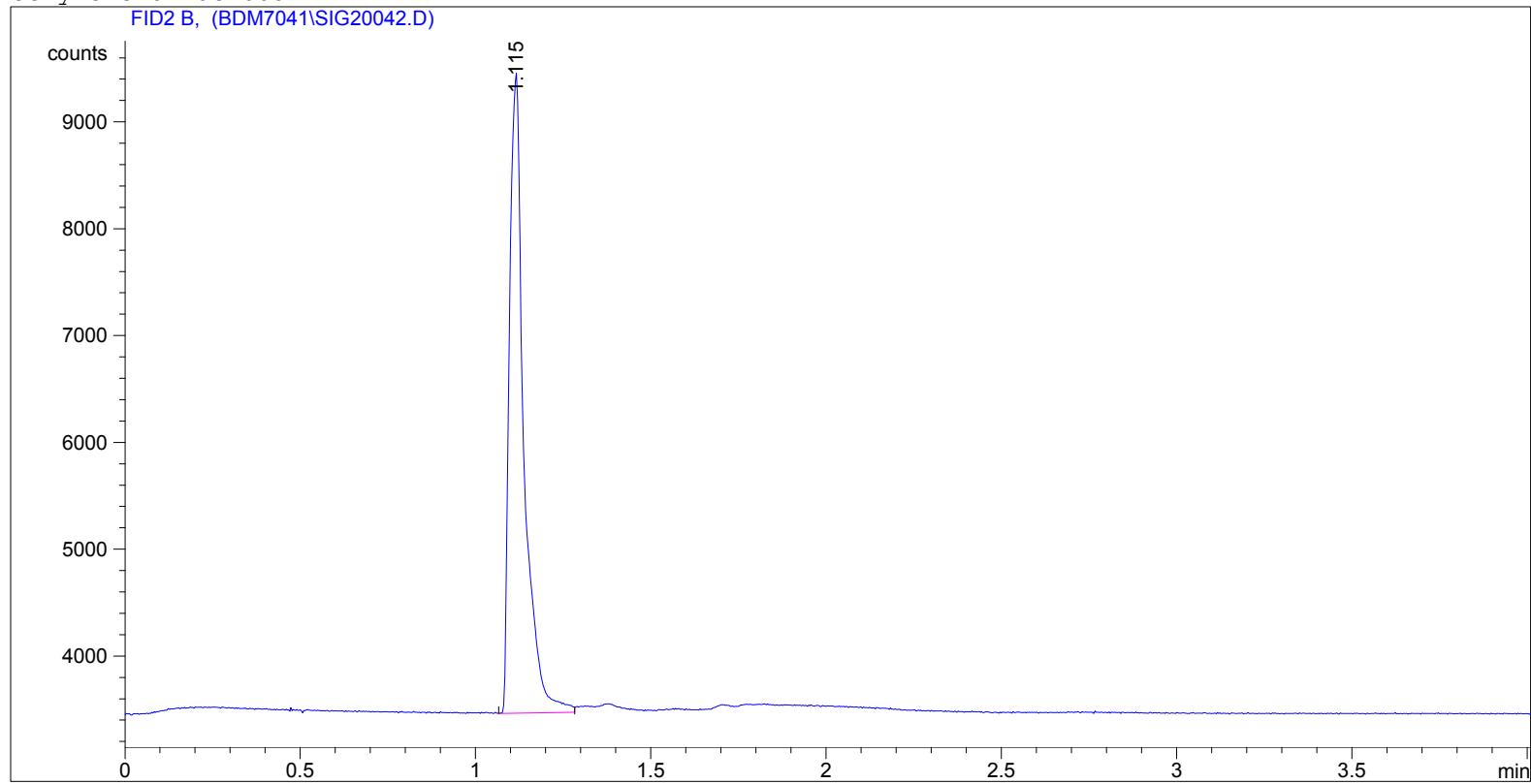
Totals : 1.75911e4 6099.64600

Results obtained with enhanced integrator!

=====
*** End of Report ***

Outlet Run 3 Inj 4

Injection Date : 8/2/2017 1:51:47 PM
Sample Name : Run 3 Out I4 Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



Area Percent Report

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.115	VV	0.0434	1.72311e4	6016.98730	1.000e2

Totals : 1.72311e4 6016.98730

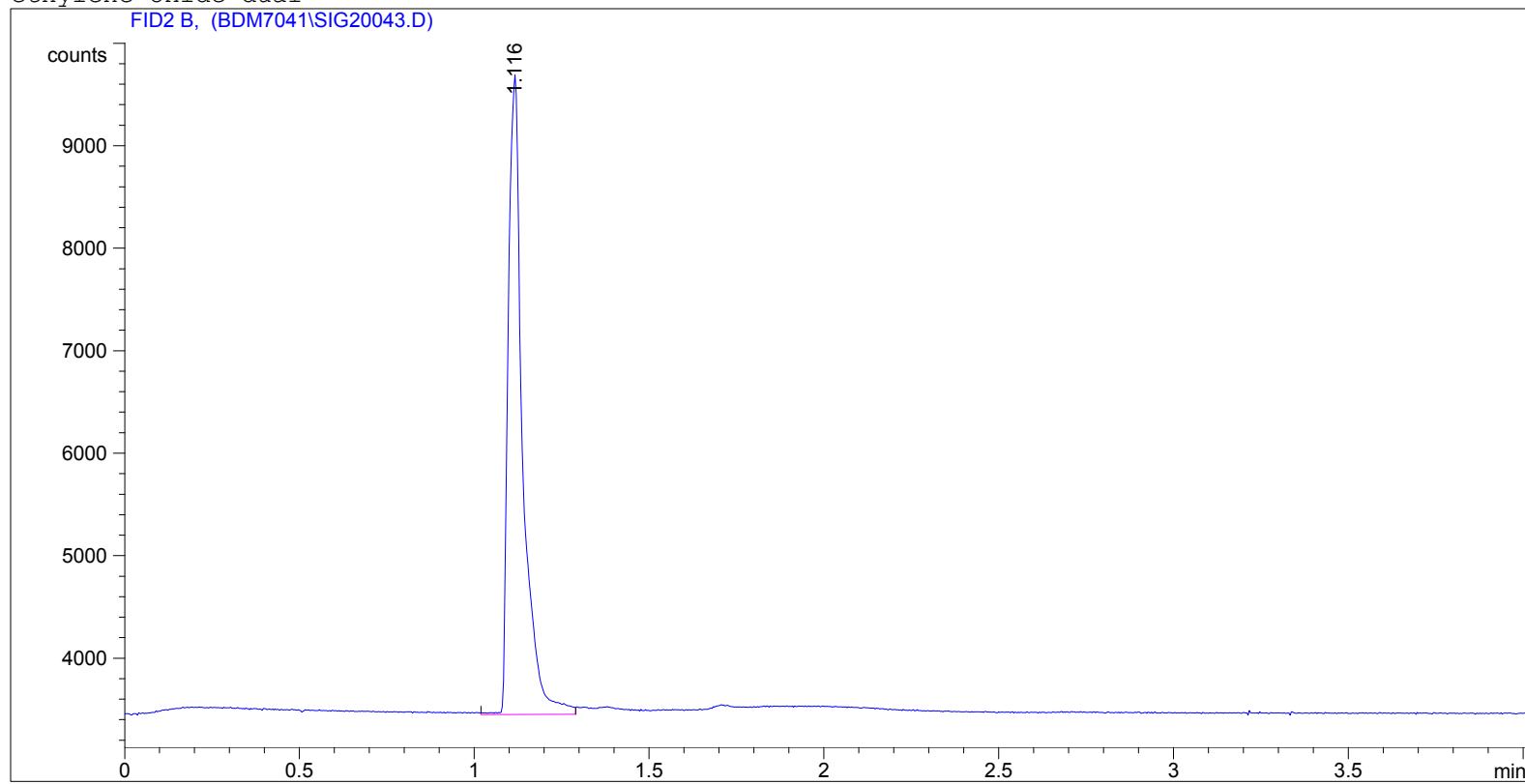
Results obtained with enhanced integrator

*** End of Report ***

Outlet Run 3 Inj 5

=====

Injection Date : 8/2/2017 2:09:02 PM
Sample Name : Run 3 Out I5 Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====

Area Percent Report

=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.116	VV	0.0447	1.80481e4	6250.03564	1.000e2

Totals : 1.80481e4 6250.03564

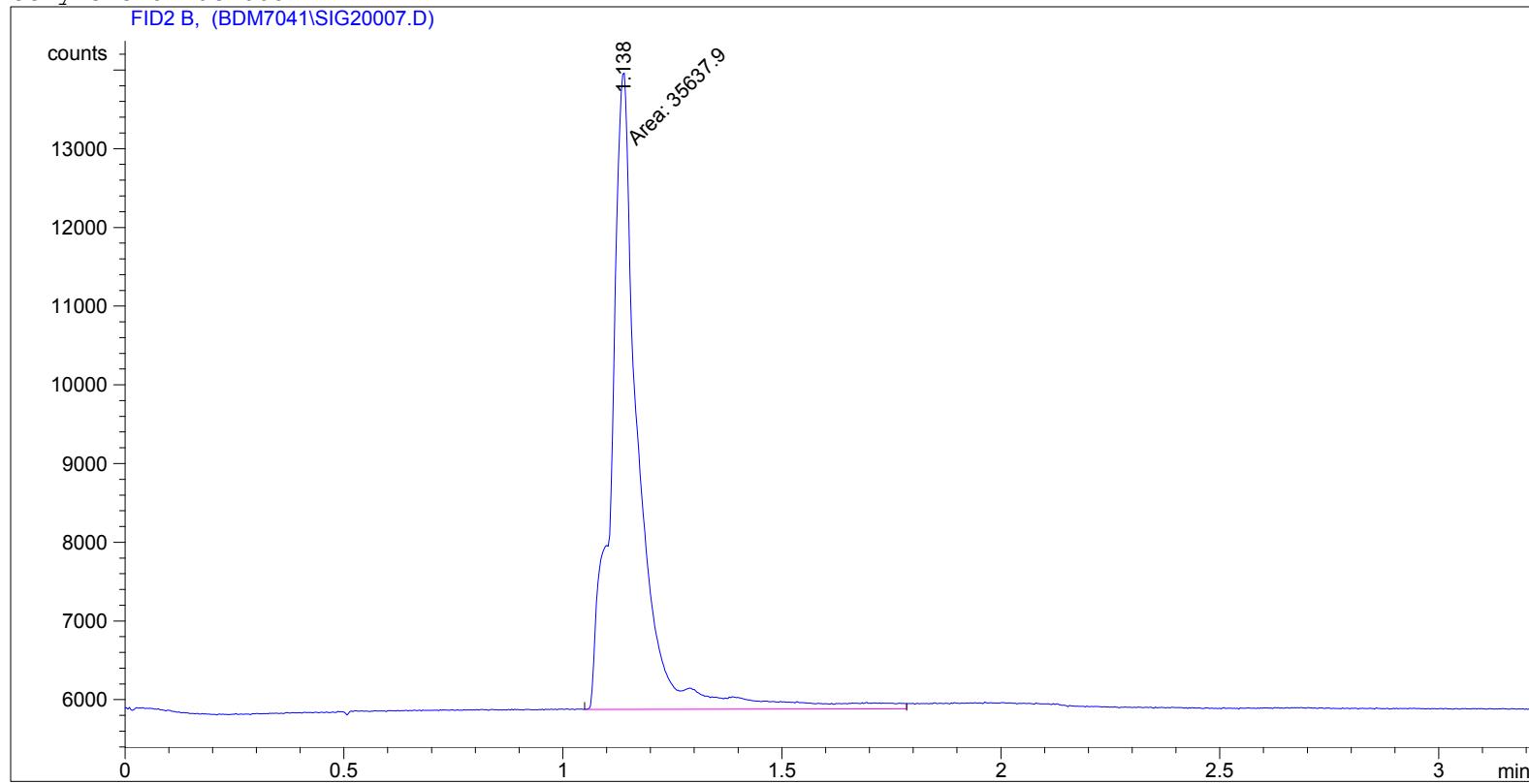
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Mid Level Cal 12 ppm EO Inj 1

```
=====
Injection Date : 8/1/2017 1:29:11 PM
Sample Name : Pre 12 ppm Inj 1
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.138	MM	0.0731	3.56379e4	8129.73926	1.000e2

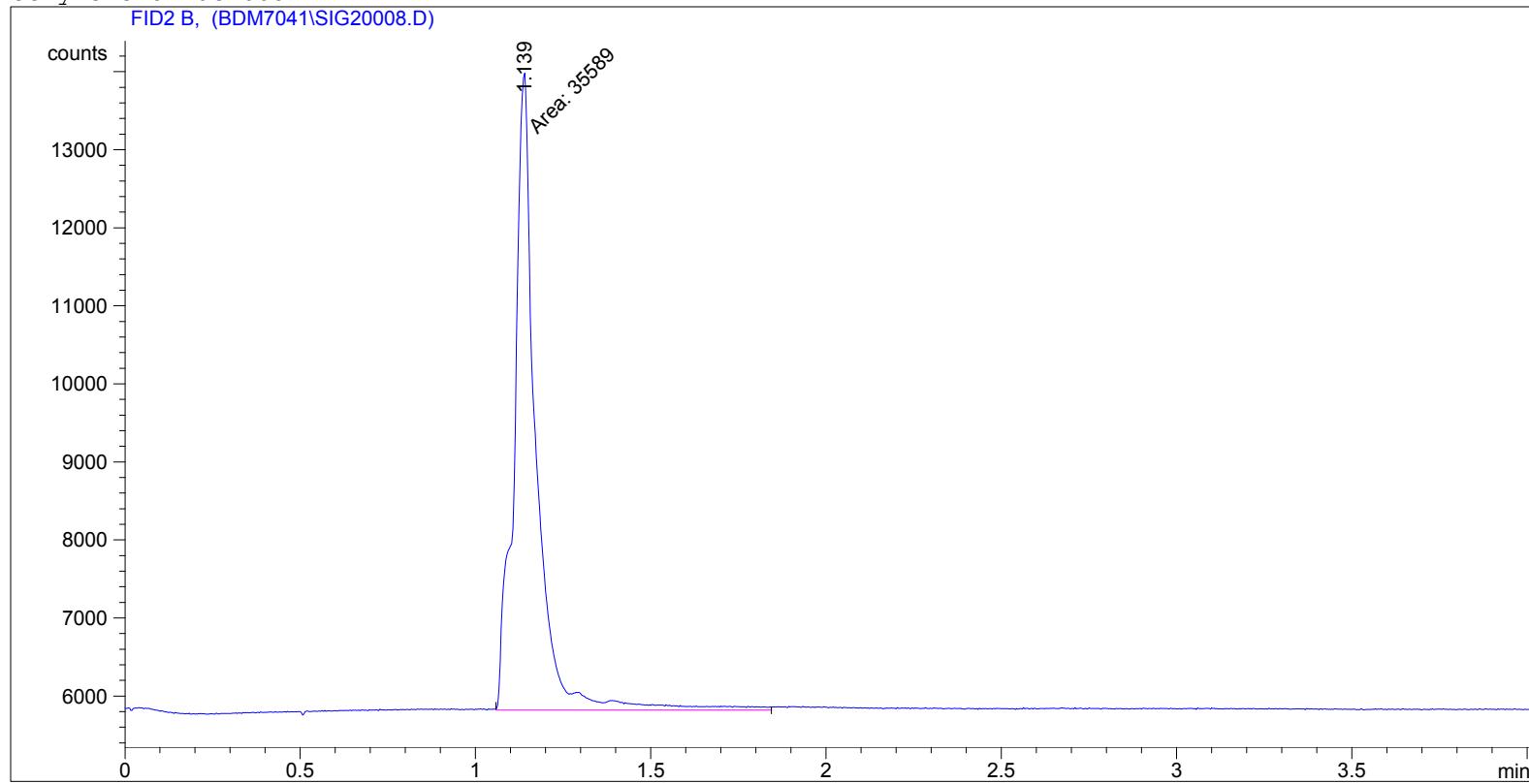
Totals : 3.56379e4 8129.73926

Results obtained with enhanced integrator!

=====
*** End of Report ***

Outlet Mid Level Cal 12 ppm EO Inj 2

```
=====
Injection Date : 8/1/2017 1:36:35 PM
Sample Name : Pre 12 ppm Inj 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.139	MM	0.0725	3.55890e4	8185.89355	1.000e2

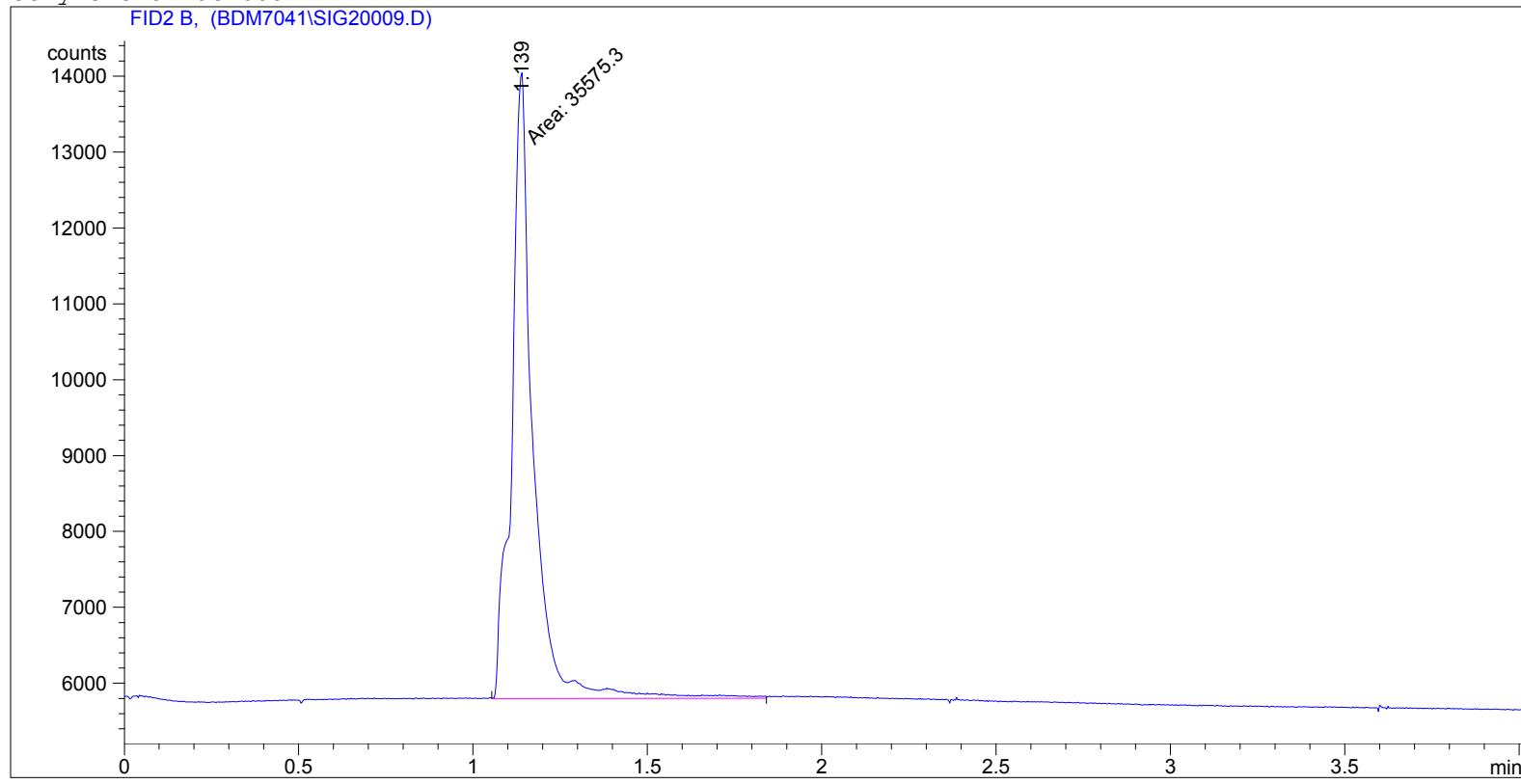
Totals : 3.55890e4 8185.89355

Results obtained with enhanced integrator!

=====
*** End of Report ***

Outlet Mid Level Cal 12 ppm EO Inj 3

```
=====
Injection Date : 8/1/2017 1:56:26 PM
Sample Name : Pre 12 ppm Inj 3
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.139	MM	0.0717	3.55753e4	8269.74121	1.000e2

Totals : 3.55753e4 8269.74121

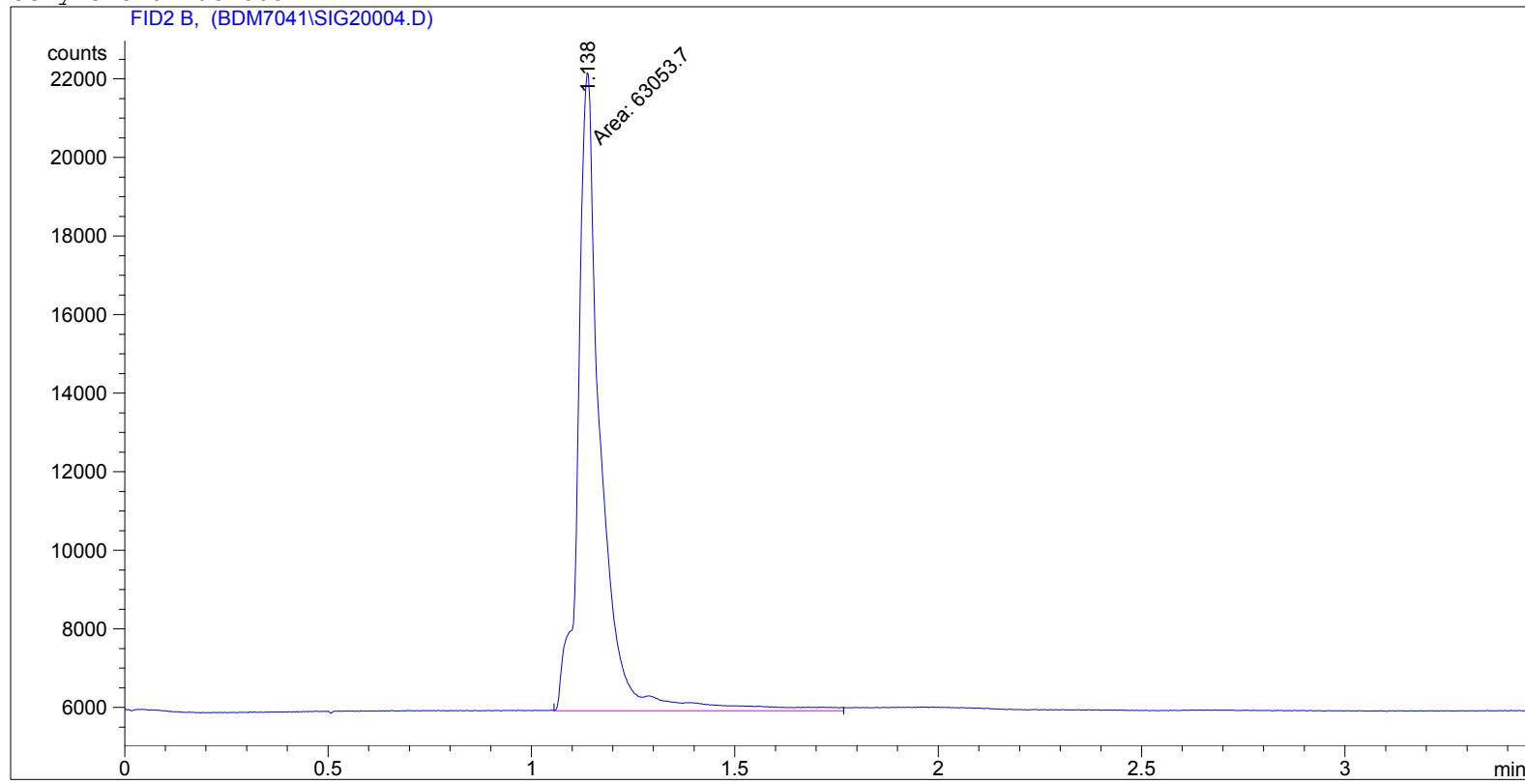
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Mid Level Cal Inj 1 25 ppm EO

```
=====
Injection Date : 8/1/2017 12:55:27 PM
Sample Name : Pre 25 ppm Inj 1
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.138	MM	0.0645	6.30537e4	1.62974e4	1.000e2

Totals : 6.30537e4 1.62974e4

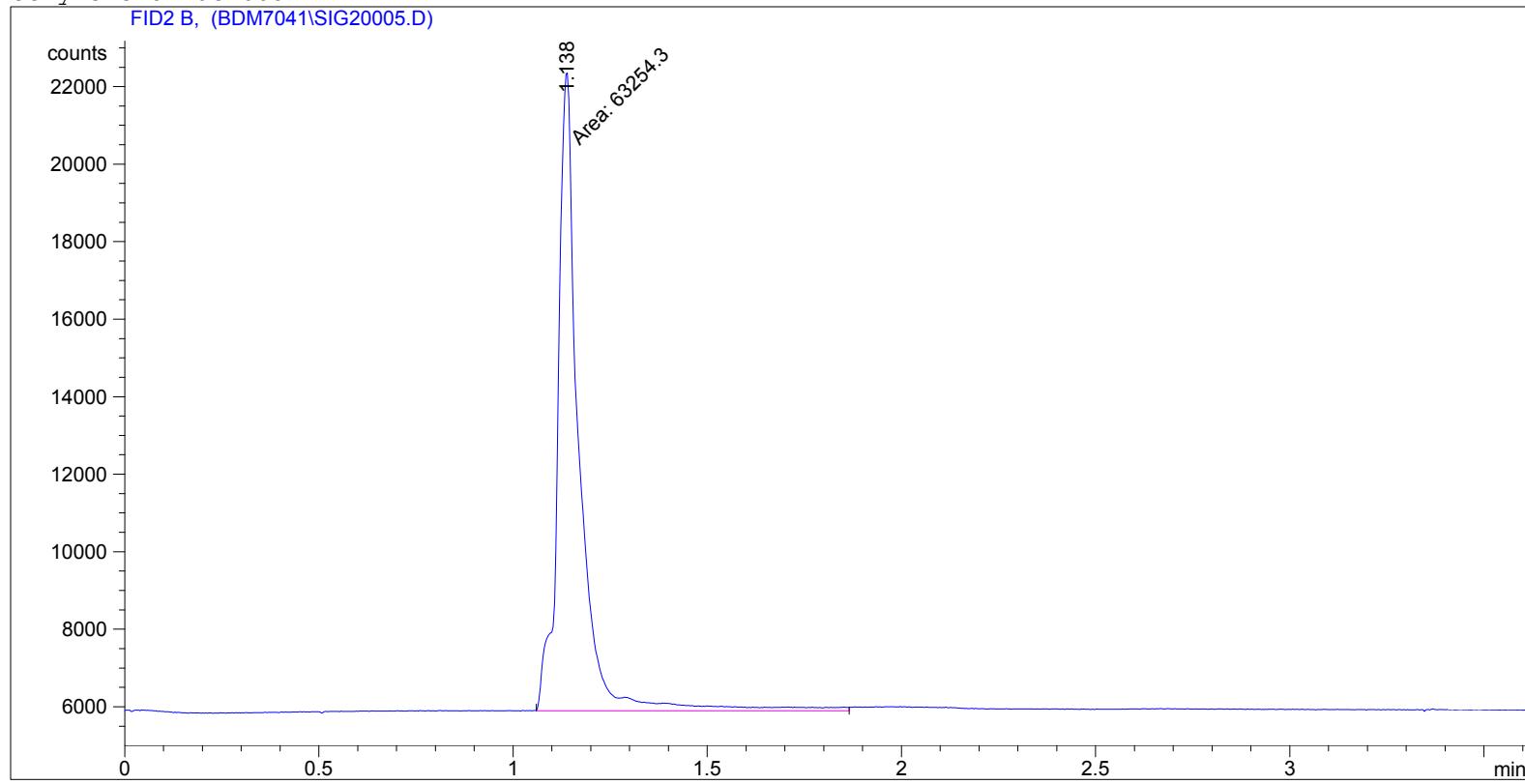
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Mid Level Cal 25 ppm EO Inj 2

```
=====
Injection Date : 8/1/2017 1:05:14 PM
Sample Name : Pre 25 ppm Inj 2
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.138	MM	0.0636	6.32543e4	1.65661e4	1.000e2

Totals : 6.32543e4 1.65661e4

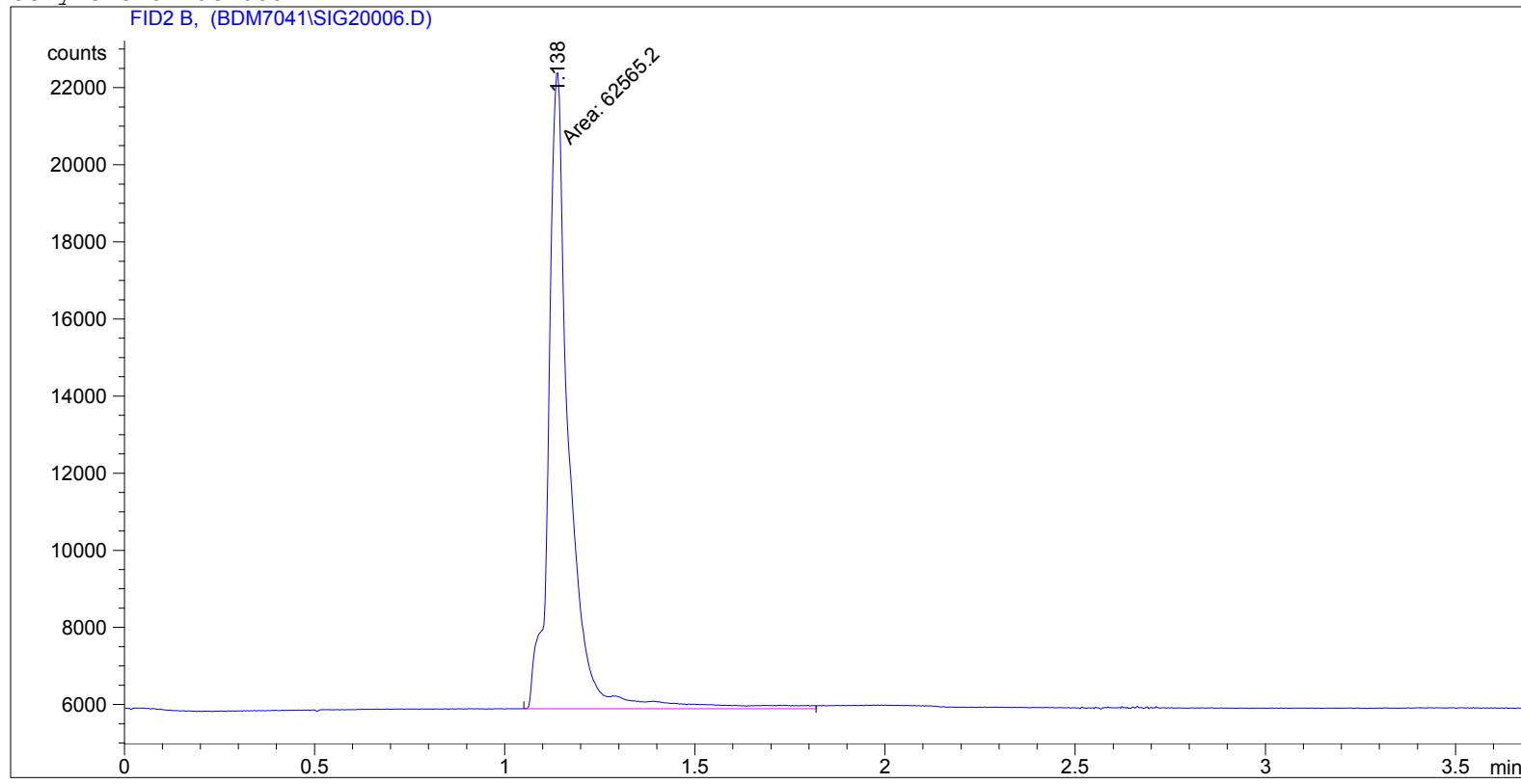
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Mid Level Cal 25 ppm EO Inj 3

```
=====
Injection Date : 8/1/2017 1:14:12 PM
Sample Name : Pre 25 ppm Inj 3
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.138	MM	0.0628	6.25652e4	1.65976e4	1.000e2

Totals : 6.25652e4 1.65976e4

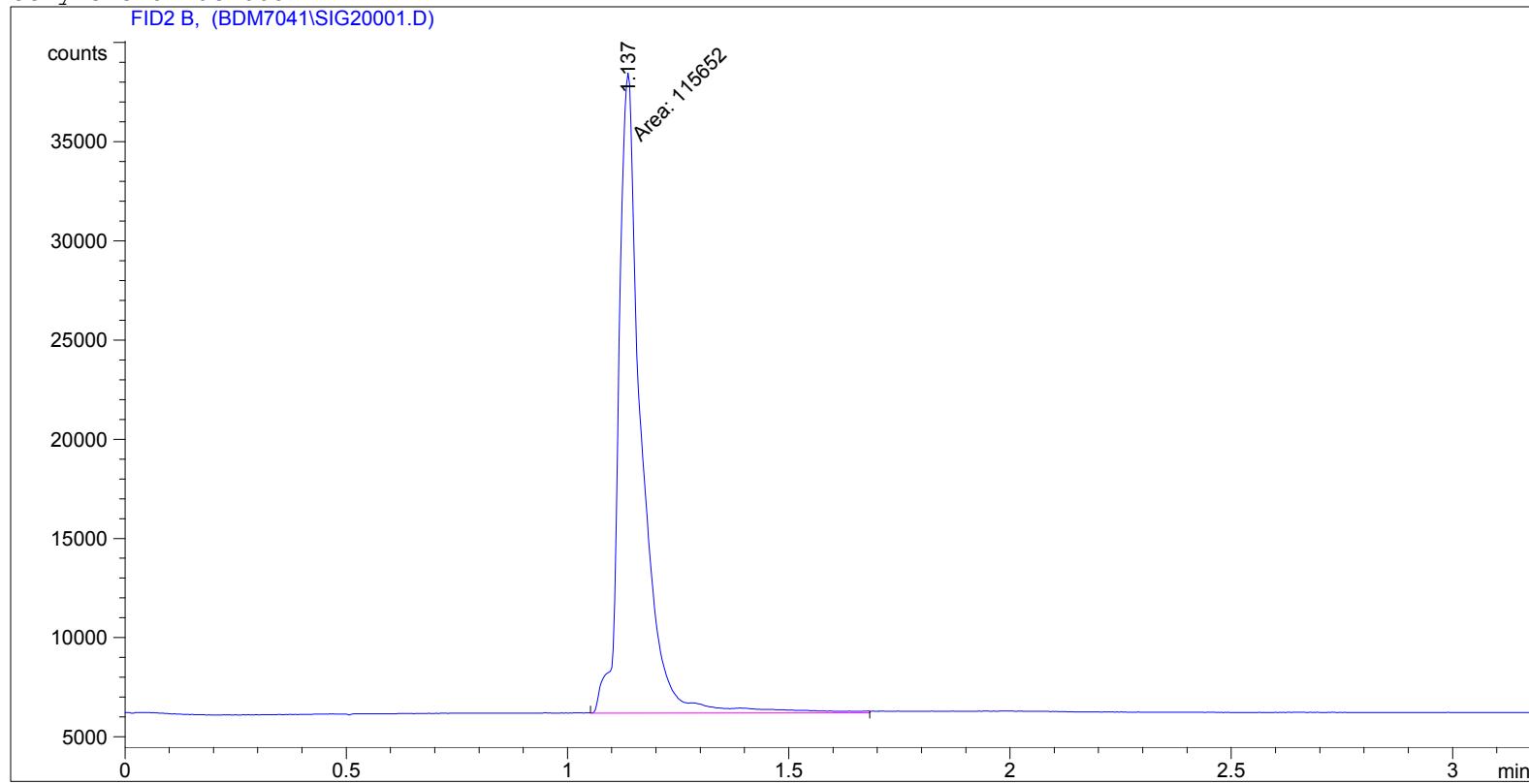
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet High Level Cal Inj 1 50 ppm EO

```
=====
Injection Date : 8/1/2017 12:16:56 PM
Sample Name : Pre 50 ppm Inj 1
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.137	MM	0.0597	1.15652e5	3.23047e4	1.000e2

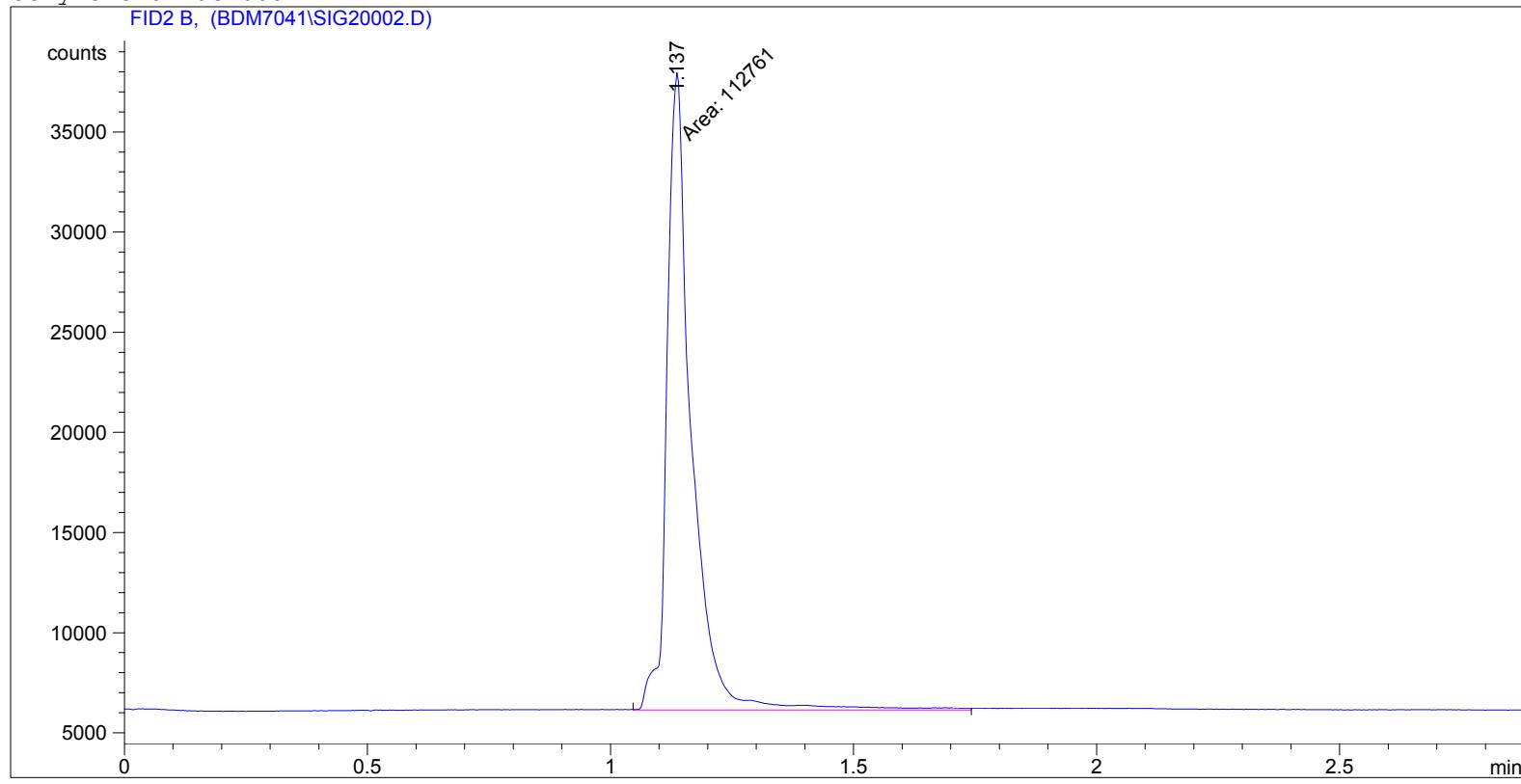
Totals : 1.15652e5 3.23047e4

Results obtained with enhanced integrator!

```
=====
*** End of Report ***
=====
```

Outlet High Level Cal Inj 2 50 ppm EO

```
=====
Injection Date : 8/1/2017 12:30:13 PM
Sample Name : Pre 50 ppm Inj 2
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.137	MM	0.0590	1.12761e5	3.18655e4	1.000e2

Totals : 1.12761e5 3.18655e4

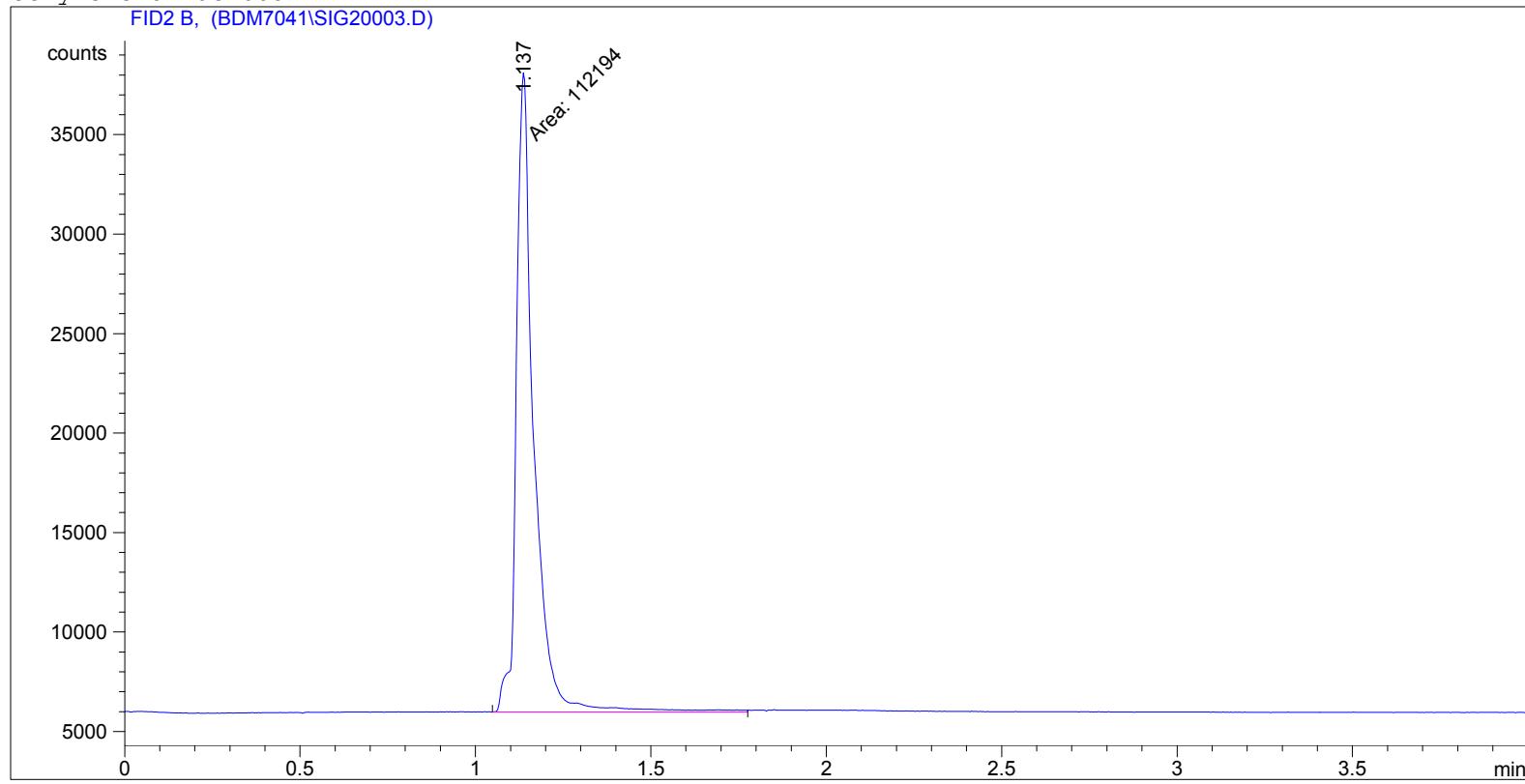
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet High Level Cal Inj 3 50 ppm EO

```
=====
Injection Date : 8/1/2017 12:41:05 PM
Sample Name : Pre 50 ppm Inj 3
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.137	MM	0.0581	1.12194e5	3.21869e4	1.000e2

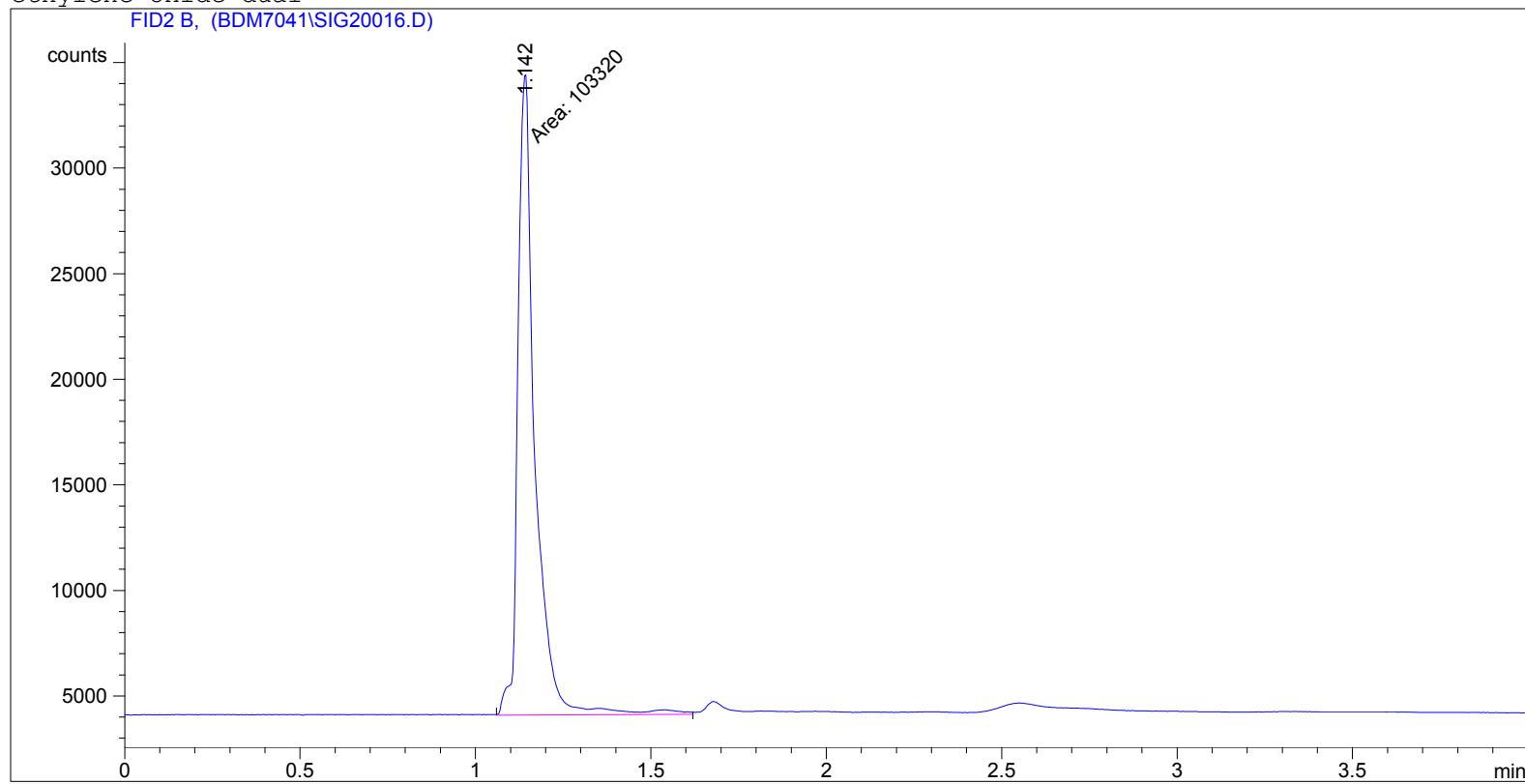
Totals : 1.12194e5 3.21869e4

Results obtained with enhanced integrator!

=====
*** End of Report ***

Outlet Lineloss 50 ppm EO Inj 1

```
=====
Injection Date : 8/1/2017 4:50:18 PM
Sample Name : Out LL Inj 1
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.142	MM	0.0565	1.03320e5	3.05039e4	1.000e2

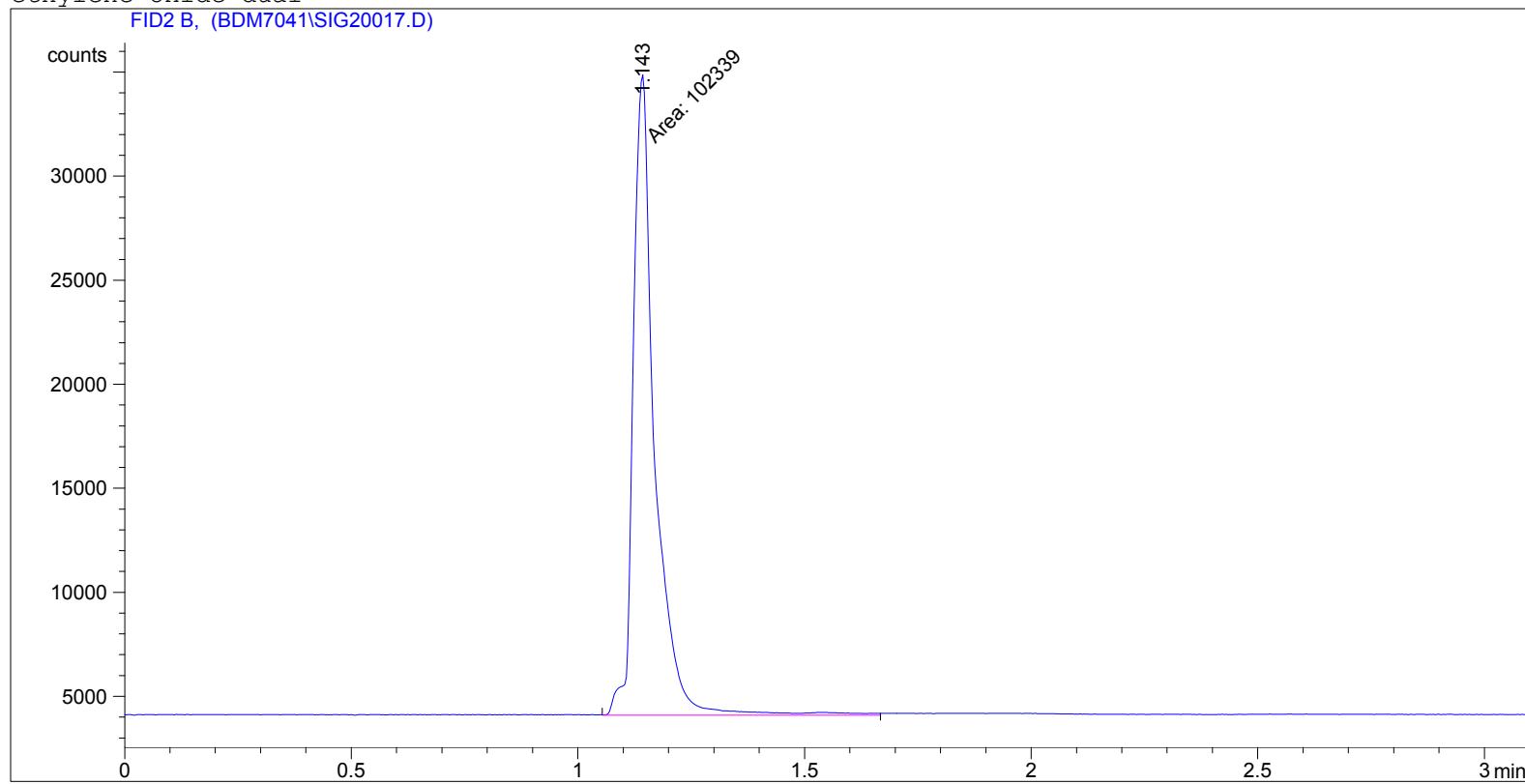
Totals : 1.03320e5 3.05039e4

Results obtained with enhanced integrator!

=====
*** End of Report ***

Outlet Lineloss 50 ppm EO Inj 2

```
=====
Injection Date : 8/1/2017 5:01:00 PM
Sample Name : Out LL Inj 2
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.143	MM	0.0553	1.02339e5	3.08564e4	1.000e2

Totals : 1.02339e5 3.08564e4

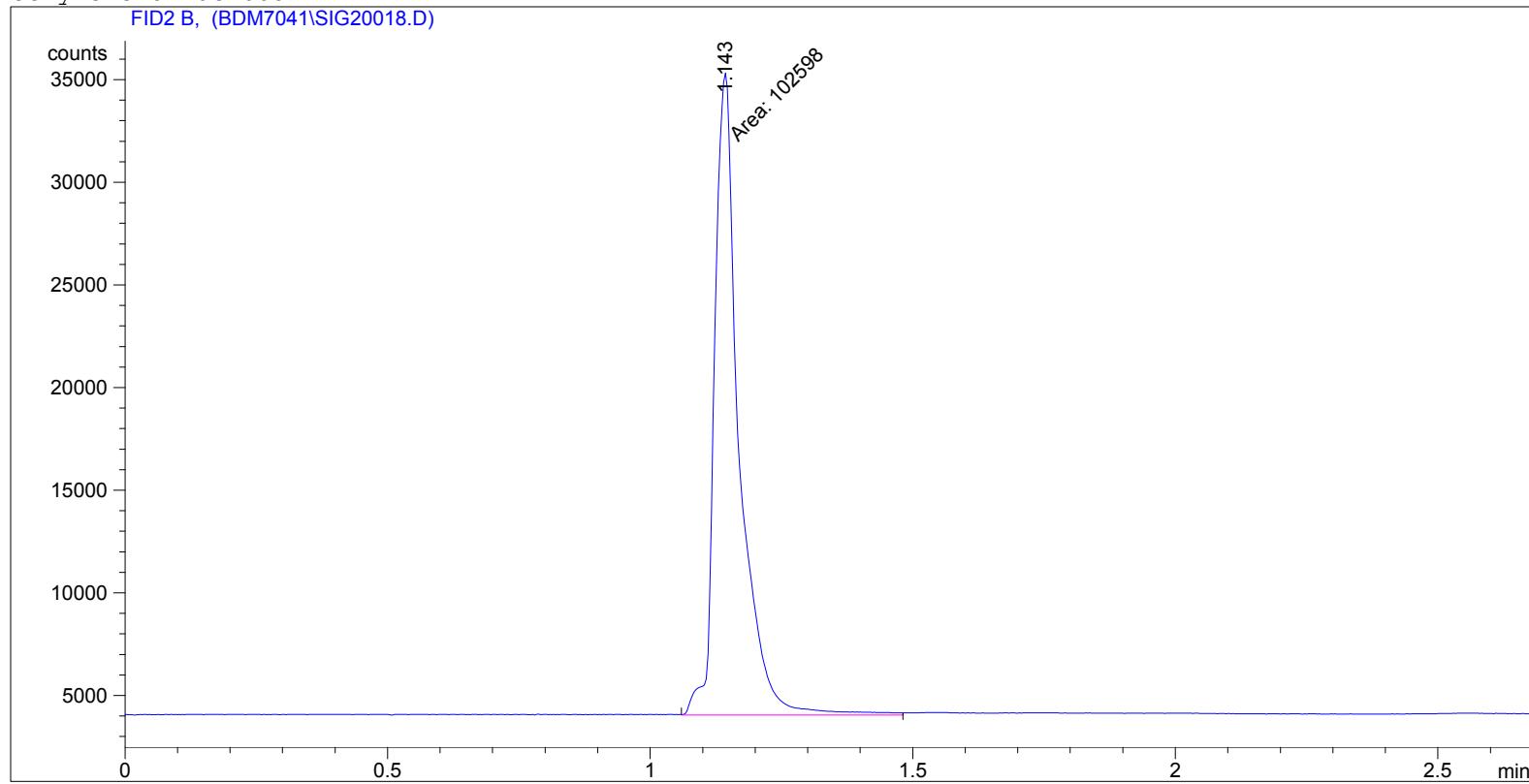
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Lineloss 50 ppm EO Inj 3

```
=====
Injection Date : 8/1/2017 5:14:47 PM
Sample Name : Out LL Inj 3
Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1
Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.143	MM	0.0546	1.02598e5	3.13225e4	1.000e2

Totals : 1.02598e5 3.13225e4

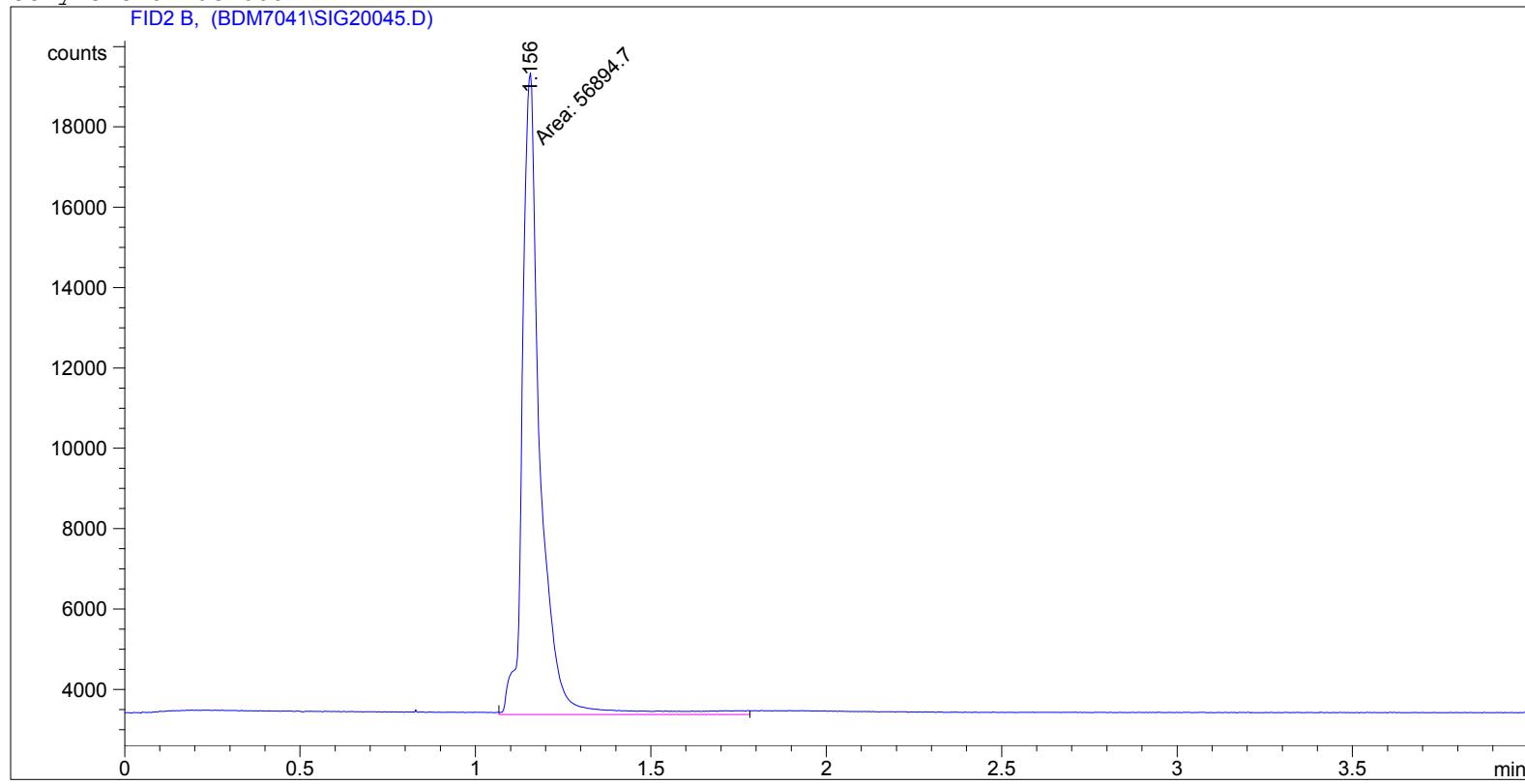
Results obtained with enhanced integrator!

=====

*** End of Report ***

Outlet Post Mid-Level Cal Gas 25 ppm EO Inj 1

```
=====
Injection Date : 8/2/2017 2:40:22 PM
Sample Name : Out Post Cal II
Acq. Operator : KM
Acq. Instrument : Instrument 1
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual
```



```
=====
Area Percent Report
=====
```

```
Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs
```

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.156	MM	0.0592	5.68947e4	1.60059e4	1.000e2

Totals : 5.68947e4 1.60059e4

Results obtained with enhanced integrator!

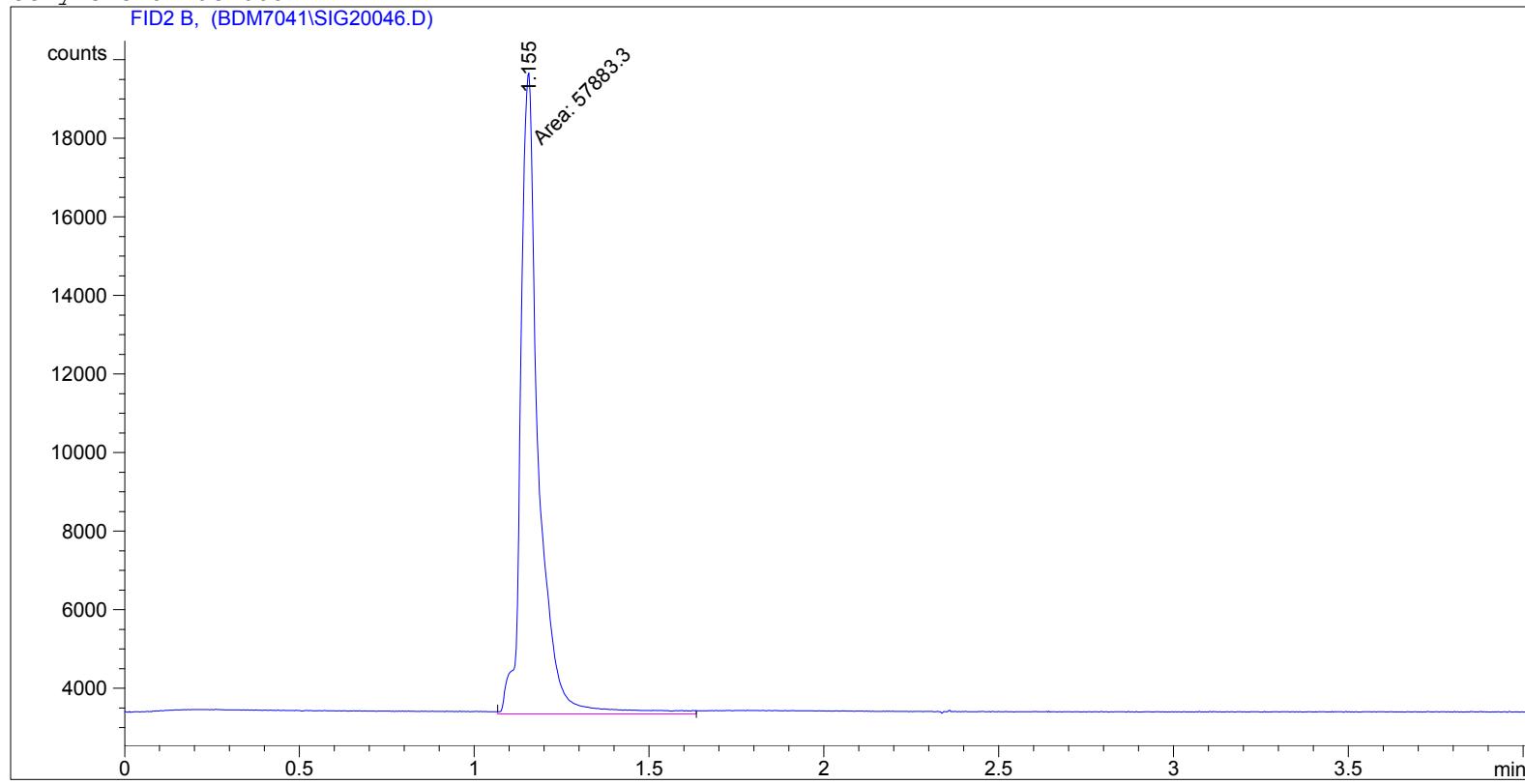
=====

*** End of Report ***

Outlet Post Mid-Level Cal Gas 25 ppm EO Inj 2

=====

Injection Date : 8/2/2017 2:55:53 PM
Sample Name : Out Post Cal I2 Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====

Area Percent Report

=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.155	MM	0.0588	5.78833e4	1.63932e4	1.000e2

Totals : 5.78833e4 1.63932e4

Results obtained with enhanced integrator!

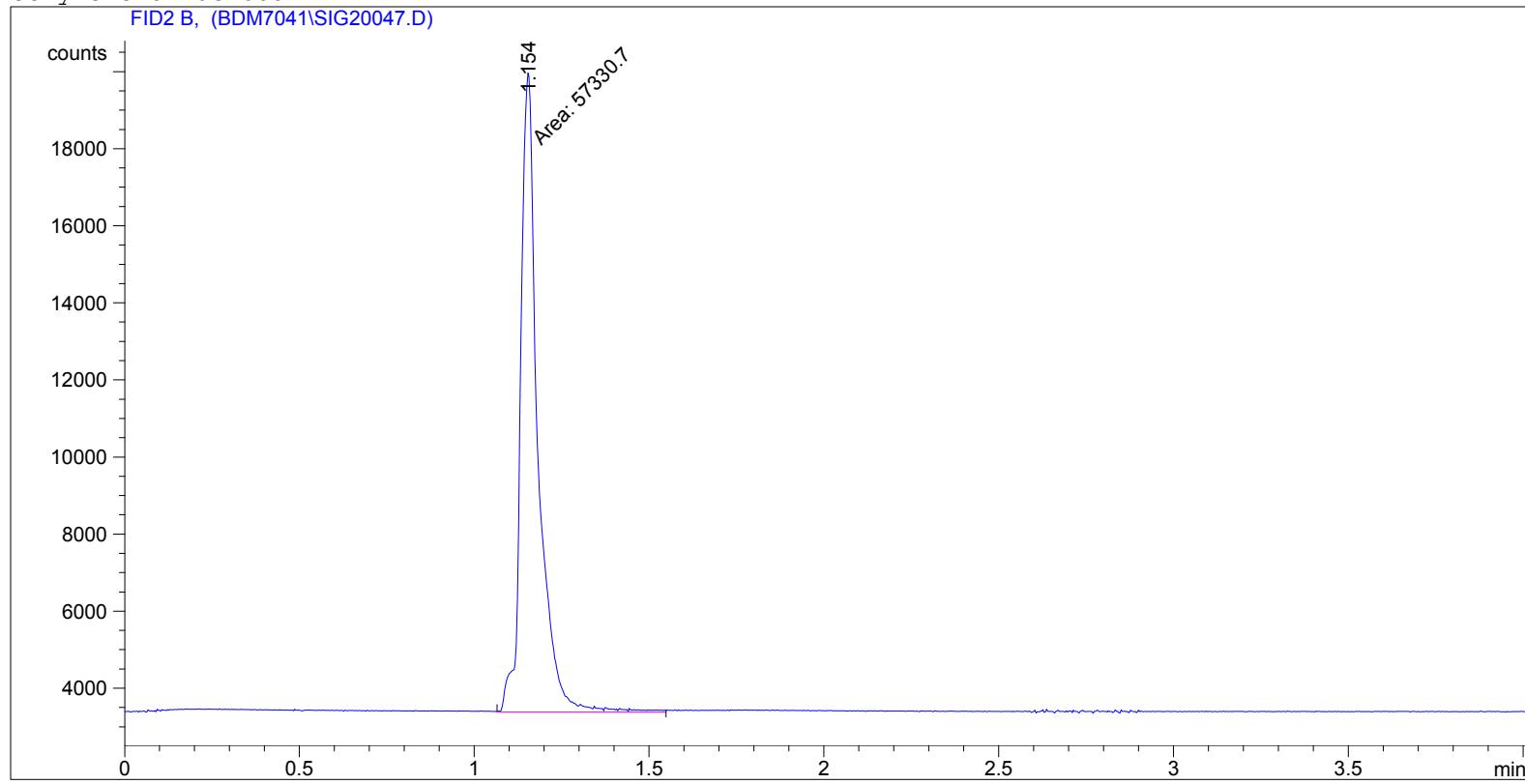
=====

*** End of Report ***

Outlet Post Mid-Level Cal Gas 25 ppm EO Inj 3

=====

Injection Date : 8/2/2017 3:01:10 PM
Sample Name : Out Post Cal I3 Location : Vial 2
Acq. Operator : KM
Acq. Instrument : Instrument 1 Inj Volume : External
Method : C:\HPCHEM\1\METHODS\ETHYDUAL.M
Last changed : 7/12/2017 11:12:31 AM by KM
ethylene oxide dual



=====

Area Percent Report

=====

Sorted By : Signal
Multiplier : 1.0000
Dilution : 1.0000
Use Multiplier & Dilution Factor with ISTDs

Signal 1: FID2 B,

Peak #	RetTime [min]	Type	Width [min]	Area counts*s	Height [counts]	Area %
1	1.154	MM	0.0575	5.73307e4	1.66273e4	1.000e2

Totals : 5.73307e4 1.66273e4

Results obtained with enhanced integrator!

=====

*** End of Report ***



Appendix Three: Operating Data

Catalyst Bed Temp BDM7041

11:00 - 184°C

11:15 - 185°C

11:30 - 186°C R1

11:45 - 187°C

12:00 - 188°C

12:15 - 189°C

12:30 - 189°C

12:45 - 190°C

13:00 - 190°C R2

13:15 - 191°C

13:30 - 192°C

13:45 - 193°C

~~13:50~~

14:00 - 193°C

14:15 - 193°C R3

14:30 -

14:45 -

15:00 -



Appendix Four: Calibration Information



Wind Tunnel Pitot Calibration

S-type Pitot ID: **P-674** Date: **13-Jan-11**
 Standard Pitot ID: **001** Personnel: **WB**
 Cp(std): **0.99** Cp(actual): **0.814**
 Part Number: **PPST12-Y-036** P(bar): **29.80**
 Test Velocity (fps): **50** T(°F): **33**

A-SIDE	ΔP_{std} (in. H ₂ O)	ΔP_s (in. H ₂ O)	Cp(s)	Deviation*
	0.599	0.898	0.809	-0.003
	0.601	0.894	0.812	-0.001
	0.603	0.889	0.815	0.003
	0.601	0.891	0.813	0.001
	AVERAGE		0.812	0.002
			Std deviation	0.003

B-SIDE	ΔP_{std} (in. H ₂ O)	ΔP_s (in. H ₂ O)	Cp(s)	Deviation*
	0.595	0.871	0.818	0.002
	0.597	0.873	0.819	0.002
	0.593	0.876	0.814	-0.002
	0.594	0.879	0.814	-0.002
	AVERAGE		0.816	0.002
			Std deviation	0.003

$$Cp(s) = Cp(std) \sqrt{\frac{\Delta P(std)}{\Delta P(s)}}$$

$$Cp(A) - Cp(B) = \boxed{0.004} \quad \{ \text{must be } < 0.010 \}$$

$$* \text{Deviation} = \{Cp(s) - AVG\ Cp(s)\} \quad \{ \text{must be } < 0.010 \}$$

Standard deviation of the deviations must be less than 0.02 for both sides.

Pitot tube S/N P-674 was calibrated in accordance with the CFR 40, Part 60
Appendix A, Method 2, Section 10.

Thelma Buckert
Signature

1/13/2011
Date



METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

- 1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range.
- 2) Record barometric pressure before and after calibration procedure.
- 3) Run at tested vacuum (from Orifice Calibration Report), for a period of time necessary to achieve a minimum volume of 10 cubic feet V_{cr} (STD). K' factors of ~8025 = 13 minutes, .5011 = 20 minutes, .3433 = 30 minutes
- 4) Record data and information in the GREEN cells, YELLOW cells are calculated.

BAROMETRIC PRESSURE (mbar):	INITIAL	FINAL	AVG (P _{bar})
	842	841	841.5

BAROMETRIC PRESSURE (in Hg):	INITIAL	FINAL	AVG (P _{bar})
	24.86426	24.8347	24.8495

TECHNICIAN/OPERATOR:	D.Maiers
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DATE:	7/5/2017
METER PART #:	NA

DGM SERIAL NUMBER:	18654653
CRITICAL ORIFICE MFG.:	Apex
METHOD 5 BOX ID:	M5-14

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT ³)			TEMPERATURES °F				ELAPSED TIME (MIN) θ	DGM ΔH (in H ₂ O)	(1) V _m (STD)	(2) V _{cr} (STD)	(3) Y	ΔH@		
				INITIAL	FINAL	NET (V _m)	AMBIENT	DGM INLET INITIAL FINAL	DGM OUTLET INITIAL FINAL	DGM AVG								
48	1	0.3433	18	255.251	270.821	15.570	74	71	74	71	74	72.5	35.00	0.475	12.8425	12.9245	1.006	1.62
	2	0.3433	18	270.821	286.465	15.644	75	75	75	75	75	75	35.00	0.475	12.8432	12.9124	1.005	1.61
	3	0.3433	18	286.465	302.111	15.646	75	75	75	75	75	75	35.00	0.475	12.8448	12.9124	1.005	1.61
63	1	0.5849	17	308.215	327.273	19.058	74	76	77	76	76	76.25	25.00	1.45	15.6544	15.7288	1.005	1.69
	2	0.5849	17	327.273	346.368	19.095	74	77	77	76	77	76.75	25.00	1.45	15.6702	15.7288	1.004	1.69
	3	0.5849	17	346.368	365.449	19.081	74	77	78	77	77	77.25	25.00	1.45	15.6441	15.7288	1.005	1.69
73	1	0.8025	15.5	368.160	387.251	19.091	74	78	79	77	77	77.75	18.00	2.85	15.7023	15.5378	0.990	1.77
	2	0.8025	15.5	387.251	406.339	19.088	74	79	80	77	77	78.25	18.00	2.85	15.6852	15.5378	0.991	1.77
	3	0.8025	15.5	406.339	425.439	19.10	74	80	80	77	78	78.75	18.00	2.85	15.6805	15.5378	0.991	1.77
															AVG = 0.990			

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:

The following equations are used to calculate the standard volumes of air passed through the DGM, V_m (std), and the critical orifice, V_{cr} (std), and the DGM calibration factor, Y. These equations are automatically calculated in the spreadsheet above.

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 1.000

$$(1) \quad V_{m(\text{std})} = K_1 * V_m * \frac{P_{\text{bar}} + (\Delta H / 13.6)}{T_m} \quad = \text{Net volume of gas sample passed through DGM, corrected to standard conditions}$$

$K_1 = 17.64 \text{ }^{\circ}\text{R/in. Hg (English)}, 0.3858 \text{ }^{\circ}\text{K/mm Hg (Metric)}$

$T_m = \text{Absolute DGM avg. temperature } (^{\circ}\text{R - English, } ^{\circ}\text{K - Metric})$

$$(2) \quad V_{cr(\text{std})} = K' * \frac{P_{\text{bar}} * \Theta}{\sqrt{T_{\text{amb}}}} \quad = \text{Volume of gas sample passed through the critical orifice, corrected to standard conditions}$$

$T_{\text{amb}} = \text{Absolute ambient temperature } (^{\circ}\text{R - English, } ^{\circ}\text{K - Metric})$

$K' = \text{Average K' factor from Critical Orifice Calibration}$

$$(3) \quad Y = \frac{V_{cr(\text{std})}}{V_{m(\text{std})}} \quad = \text{DGM calibration factor}$$

AVERAGE ΔH@ = 1.69

$$\Delta H@ = \left(\frac{0.75 \theta}{V_{cr(\text{std})}} \right)^2 \Delta H \left(\frac{V_{m(\text{std})}}{V_m} \right)$$



METHOD 5 DRY GAS METER CALIBRATION USING CRITICAL ORIFICES

- 1) Select three critical orifices to calibrate the dry gas meter which bracket the expected operating range.
- 2) Record barometric pressure before and after calibration procedure.
- 3) Run at tested vacuum (from Orifice Calibration Report), for a period of time necessary to achieve a minimum volume of 10 cubic feet Vcr (STD). K' factors of ~.8025 = 13 minutes, .5011 = 20 minutes, .3433 = 30 minutes
- 4) Record data and information in the GREEN cells, YELLOW cells are calculated.

DATE: 8/5/2017
METER PART #: NA

DGM SERIAL NUMBER: 18654653
CRITICAL ORIFICE MFG: Apex
METHOD 5 BOX ID: M5-14

	INITIAL	FINAL	AVG (P _{bar})
BAROMETRIC PRESSURE (mbar):	836	836	836

	INITIAL	FINAL	AVG (P _{bar})
BAROMETRIC PRESSURE (in Hg):	24.68708	24.6871	24.6871

TECHNICIAN/OPERATOR: Phil Brock

ORIFICE #	RUN #	K' FACTOR (AVG)	TESTED VACUUM (in Hg)	DGM READINGS (FT ³)			TEMPERATURES °F				ELAPSED TIME (MIN) Θ	DGM ΔH (in H ₂ O)	(1) V _m (STD)	(2) V _{cr} (STD)	(3) Y	ΔH _② Pre Cal	AVG DGM ΔH Pre Cal	AVG DGM Yd Pre Cal
				INITIAL	FINAL	NET (V _m)	AMBIENT	DGM INLET INITIAL	DGM OUTLET FINAL	DGM AVG								
63	1	0.5849	17.5	759.002	770.448	11.446	77	74	76	72	74	74	15.00	1.45	9.380	9.3493	0.997	1.72
	2	0.5849	17.5	785.0	796.496	11.496	78	78	79	76	77	77.5	15.00	1.45	9.3596	9.3406	0.998	1.71
	3	0.5849	17.5	796.496	808.145	11.649	79	79	79	77	78	78.25	15.00	1.45	9.4710	9.3320	0.985	1.71
																AVG =	0.993	

USING THE CRITICAL ORIFICES AS CALIBRATION STANDARDS:

The following equations are used to calculate the standard volumes of air passed through the DGM, V_m (std), and the critical orifice, V_{cr} (std), and the DGM calibration factor, Y. These equations are automatically calculated in the spreadsheet above.

AVERAGE DRY GAS METER CALIBRATION FACTOR, Y = 0.993

Yd Difference Pre and Post Ca
0.67% Yd

$$(1) \quad V_{m(\text{std})} = K_1 * V_m * \frac{P_{\text{bar}} + (\Delta H / 13.6)}{T_m} \quad = \text{Net volume of gas sample passed through DGM, corrected to standard conditions}$$

K₁ = 17.64 °R/in. Hg (English), 0.3858 °K/mm Hg (Metric)

T_m = Absolute DGM avg. temperature (°R - English, °K - Metric)

$$\Delta H_{②} = \left(\frac{0.75 \Theta}{V_{cr(\text{std})}} \right)^2 \Delta H \left(\frac{V_{m(\text{std})}}{V_m} \right)$$

$$(2) \quad V_{cr(\text{std})} = K' * \frac{P_{\text{bar}} * \Theta}{\sqrt{T_{\text{amb}}}} \quad = \text{Volume of gas sample passed through the critical orifice, corrected to standard conditions}$$

T_{amb} = Absolute ambient temperature (°R - English, °K - Metric)

K' = Average K' factor from Critical Orifice Calibration

$$(3) \quad Y = \frac{V_{cr(\text{std})}}{V_{m(\text{std})}} \quad = \text{DGM calibration factor}$$

CERTIFICATE OF ANALYSIS

Grade of Product: CERTIFIED STANDARD-SPEC

Customer: AIR LIQUIDE POLLUTION INC
Part Number: X02NI99C15A5263 Reference Number: 126-400855163-1
Cylinder Number: ALM-014712 Cylinder Volume: 144.4 CF
Laboratory: 124 - LaPorte Mix (SAP) - TX Cylinder Pressure: 2015 PSIG
Analysis Date: Feb 15, 2017 Valve Outlet: 350
Lot Number: 126-400855163-1

Expiration Date: Feb 15, 2019

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

ANALYTICAL RESULTS

Component	Req Conc	Actual Concentration (Mole %)	Analytical Uncertainty
ETHYLENE OXIDE	50.00 PPM	50.02 PPM	+/- 2%
NITROGEN	Balance		

Notes:

AIR LIQUIDE POLLUTION INC

PO#: D0OFC

PO#: 4510145652



Signature on file

Approved for Release

CERTIFICATE OF ANALYSIS

Grade of Product: CERTIFIED STANDARD-SPEC

Customer: AIR LIQUIDE POLLUTION INC
Part Number: X02NI99C15A0631
Cylinder Number: ALM013685
Laboratory: 124 - LaPorte Mix (SAP) - TX
Analysis Date: Feb 15, 2017
Lot Number: 126-400855162-1

Reference Number: 126-400855162-1
Cylinder Volume: 144.9 CF
Cylinder Pressure: 2015 PSIG
Valve Outlet: 350

Expiration Date: Feb 15, 2019

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

ANALYTICAL RESULTS

Component	Req Conc	Actual Concentration (Mole %)	Analytical Uncertainty
ETHYLENE OXIDE	5210 PPM	5222 PPM	+/- 2%
NITROGEN	Balance		

Notes:

AIR LIQUIDE POLLUTION INC

PO#: D0OFC

PO#: 4510145652

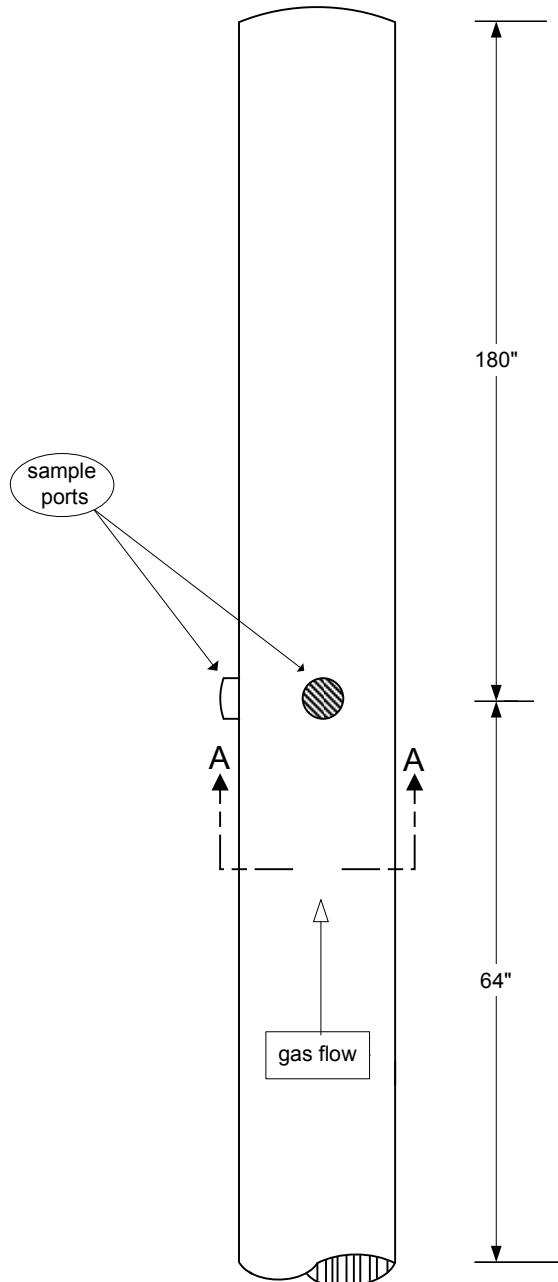
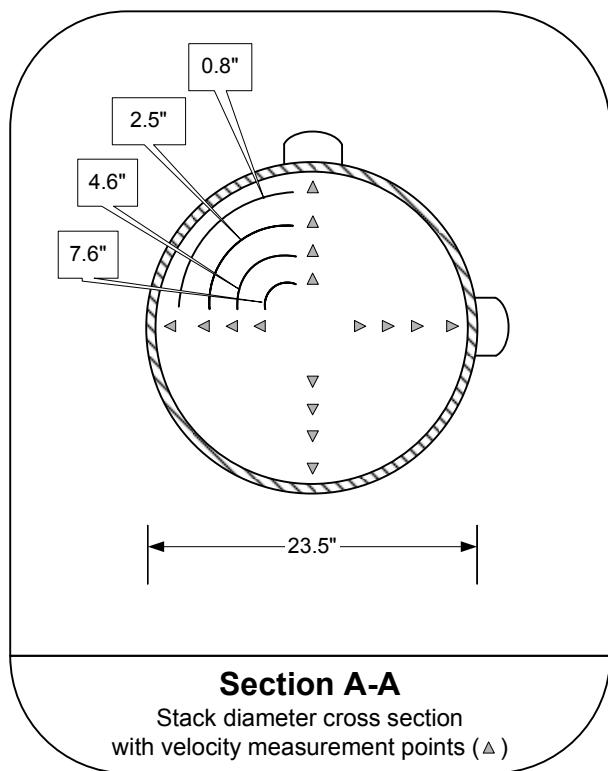


Signature on file

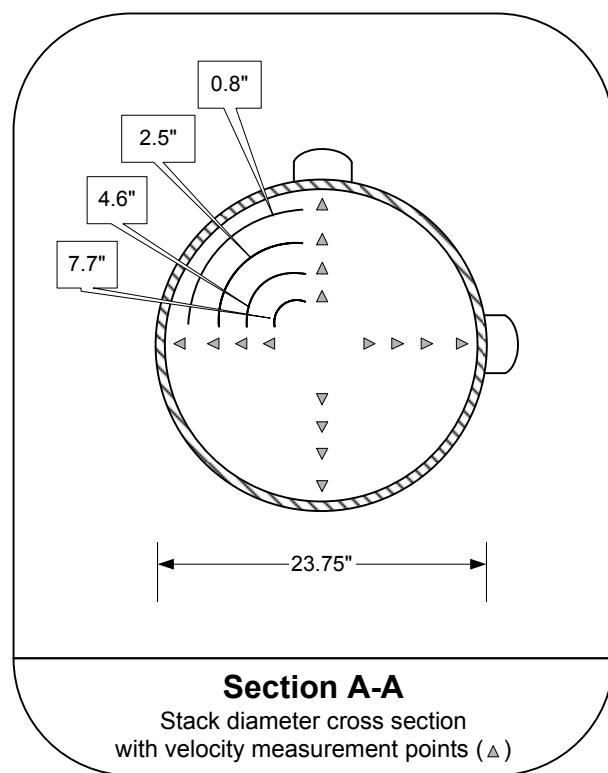
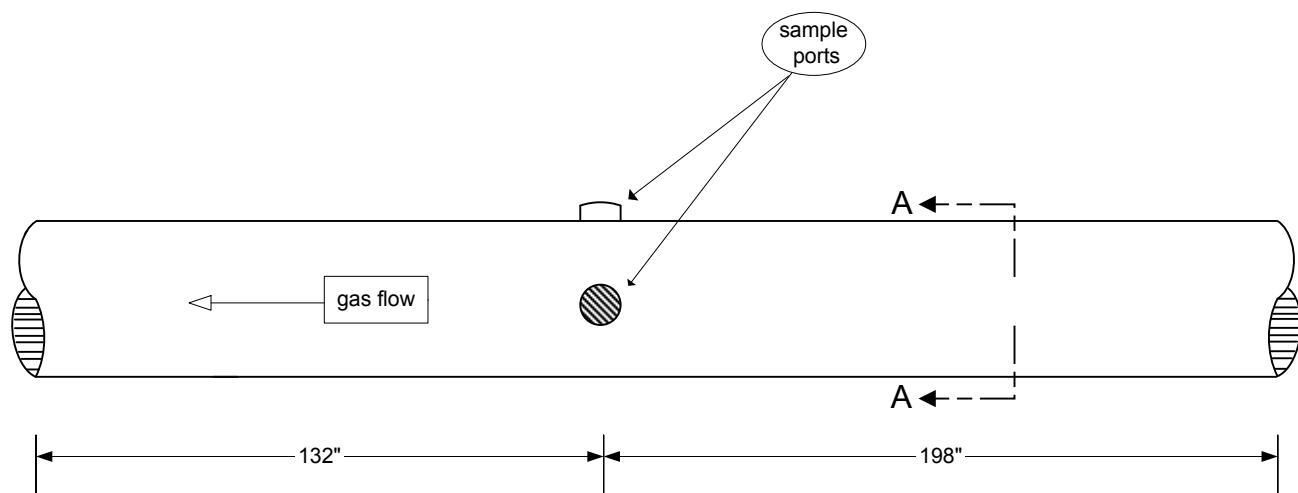
Approved for Release



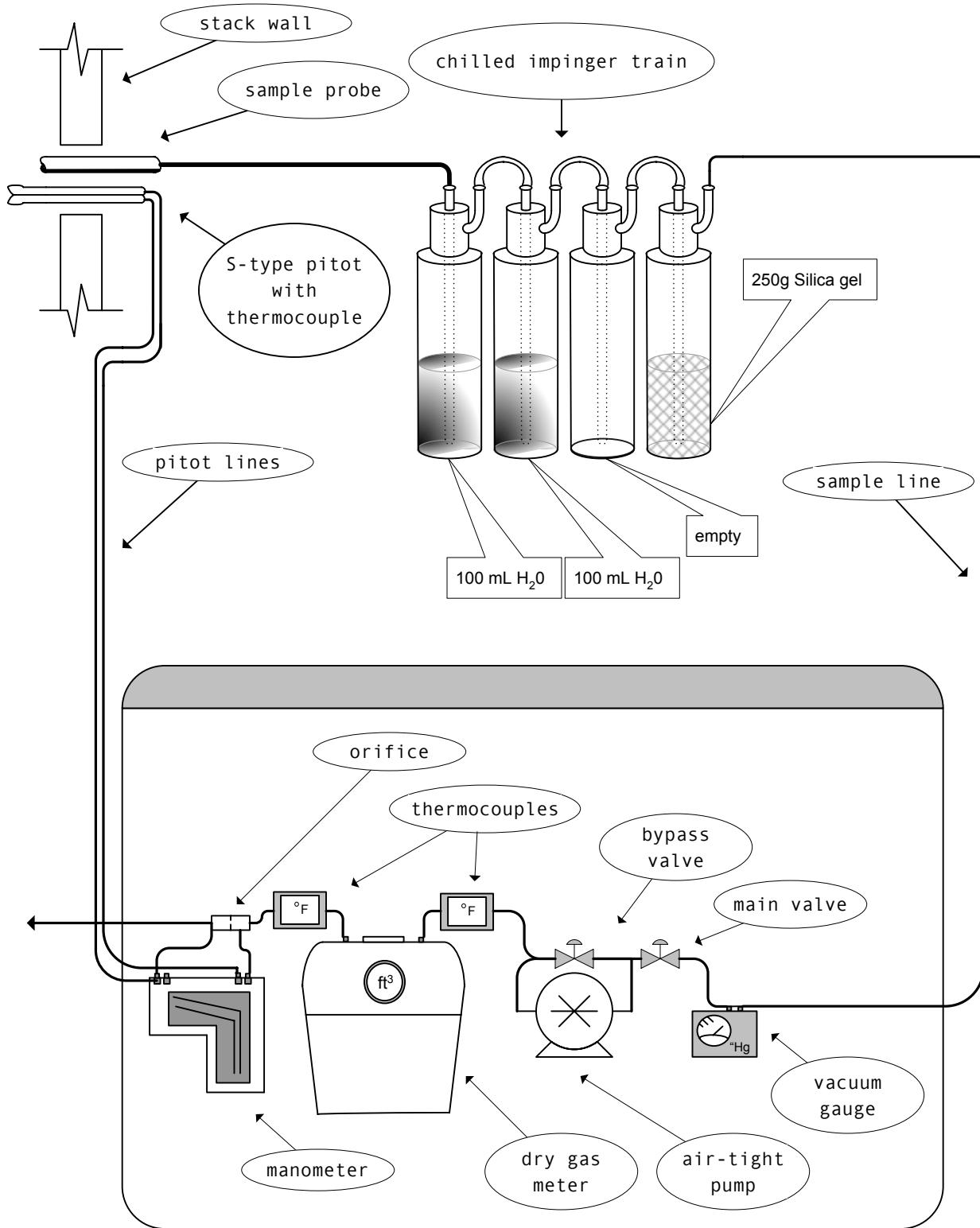
Appendix Five: Schematics



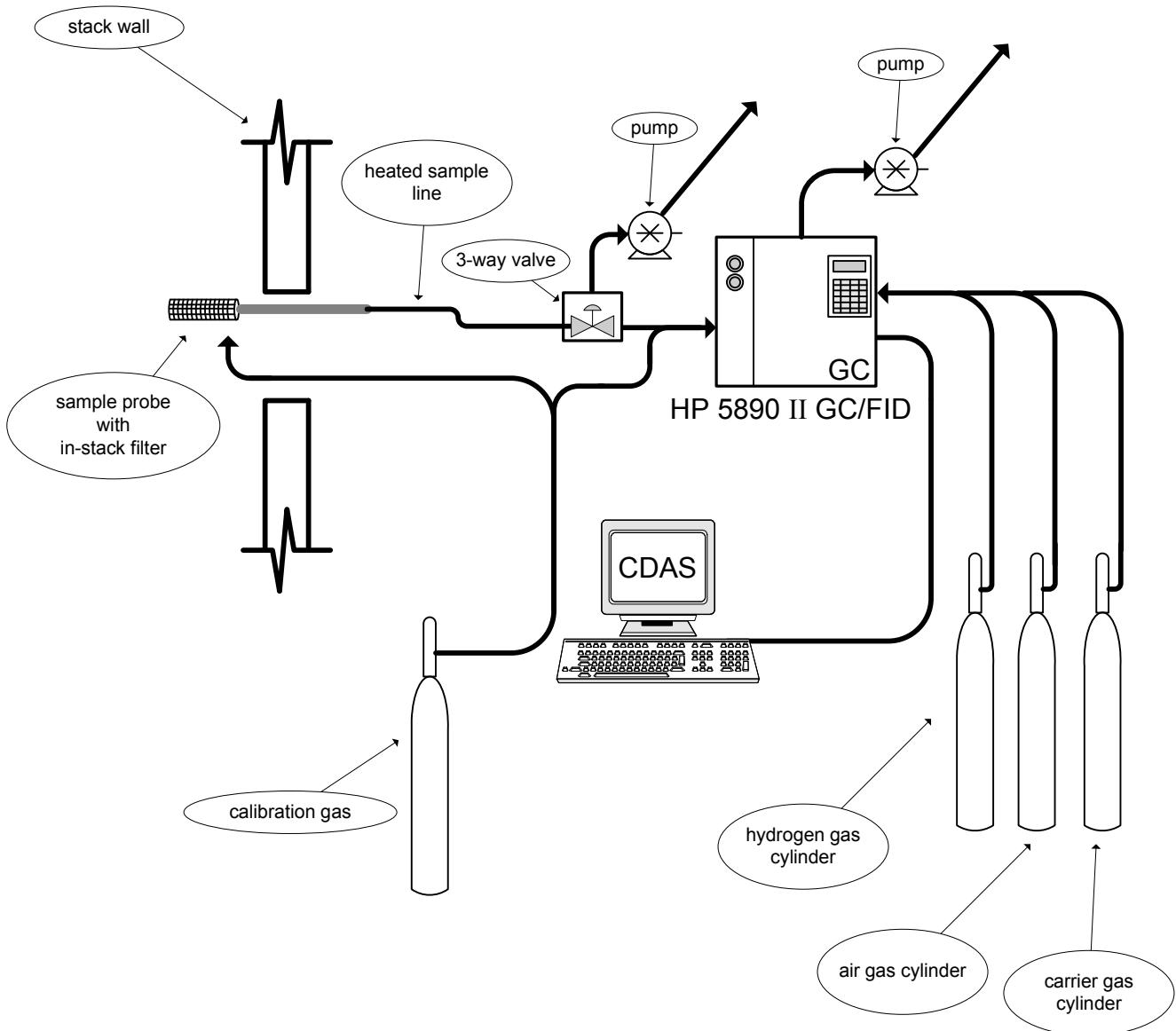
BD Medical
Sandy, Utah
Catalytic Oxidizer (Outlet)
Stack Sampling Location Schematic
(not to scale)



BD Medical
Sandy, Utah
Catalytic Oxidizer (Inlet)
Stack Sampling Location Schematic
(not to scale)



EPA Methods 1,2, & 4
sampling train schematic



EPA Method 18
sampling train schematic